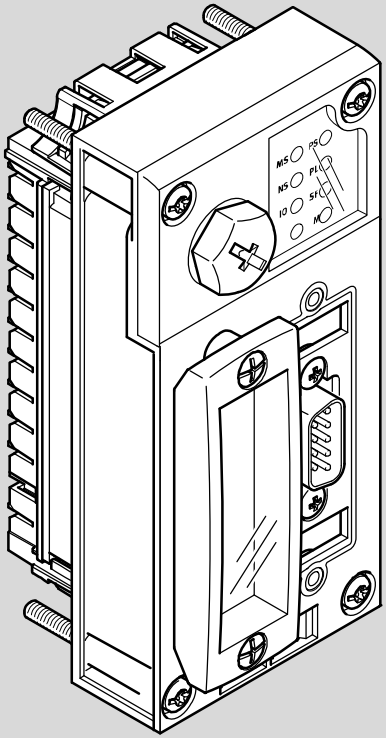
Terminal CPX

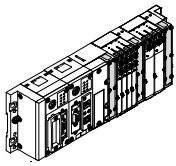
Bus node CPX-FB14



FESTO

Description

CANopen network-protocol



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Intended use

The bus node CPX-FB14 described in this description has been designed exclusively for use as a participant on the CANopen fieldbus.

The CPX terminal must only be used as follows:

– As intended in industrial environments;
outside of industrial environments, e.g. in commercial and mixed-residential areas, actions to suppress interference may have to be taken

– in original status without unauthorised modifications;
only the conversions or modifications described in the documentation supplied with the product are permitted.

– in excellent technical condition.

The limit values specified for pressures, temperatures, electrical data, torques etc. must be observed.

Comply with the legal rules and regulations and standards, rules of the testing organisations and insurance companies and national specifications applicable for the location.

Warning
- Use only PELV circuits for the electrical power supply in accordance with IEC/EN 60204-1 (Protective Extra-Low Voltage, PELV).
- Observe also the general requirements for PELV circuits in accordance with IEC/EN 60204-1.
- Use only voltage sources that ensure a reliable electric separation of operating voltage in accordance with IEC/EN 60204-1.
- Always connect both circuits for operating and load voltage supply.

Through the use of PELV circuits, protection against electric shock (protection against direct and indirect contact) is ensured in accordance with IEC/EN 60204-1.

Target group

This description is intended exclusively for technicians trained in control and automation technology who have experience in installing, commissioning, programming and diagnosing participants on the CANopen fieldbus.

Service

Please consult your local Festo repair service if you have any technical problems.

Instructions regarding this description

This description contains specific information on installing, configuring, parameterising, commissioning, programming and diagnosing with the CPX bus node for CANopen.

This description refers to the following versions:

Versions [1]	Supports
Rev 26 (5 Jun. 13)	– Layer setting service (➔ section 2.2.1)
Rev 24 (19 Nov. 08) Rev 20 (10 Oct. 07)	– Virtual modules via the function assignment object (➔ section 2.4.13)
Rev 14 (12 Jul. 05)	– CPX-FEC – CPX-CP interface
EDS file from 23 Apr. 13	
[1] Software status (SW) or revision no. (Rev) ➔ type plate	

Tab. 0/1: Revisions of the CPX-FB14 until June 2013

An overview of the structure of the CPX terminal user documentation is contained in the CPX system description.

General basic information about the mode of operation, mounting, installation and commissioning of CPX terminals can be found in the CPX system description.

Information about additional CPX modules can be found in the description for the respective module.

Important user information

Danger categories

This description includes instructions on the possible dangers which can occur if the product is used incorrectly. These instructions are marked with a signal word (Warning, Caution, etc.), printed on a shaded background and marked additionally with a pictogram.
A distinction is made between the following danger warnings:

Warning
... means that failure to observe this instruction may result in serious personal injury or material damage.

Caution
... means that failure to observe this instruction may result in personal injury or material damage.

Note
... means that failure to observe this instruction may result in material damage.

In addition, the following pictogram marks passages in the text which describe activities with electrostatically sensitive devices:

Electrostatically sensitive devices: Incorrect handling may cause damage to devices.

Marking of special information

The following pictograms mark passages in the text which contain special information.

Pictograms

Information:
Recommendations, tips and references to other information sources.

Accessories:
Specifications on necessary or useful accessories for the Festo product.

Environment:
Information on the environmentally friendly use of Festo products.

Text designations

- Bullets denote activities that may be carried out in any desired order.

1. Numerals denote activities that must be carried out in the sequence specified.

– Arrowheads indicate general lists.

The following product-specific terms and abbreviations are used in this description:

Term/abbreviation	Significance
AO, AI	Analogue output, analogue input
Bus nodes	Connects the CPX terminal to the fieldbus or network; it transmits control signals to the connected CPX and pneumatic modules and monitors their functional capability
CEC	CODESYS controller, e.g. CPX–CEC/CPX–CEC..., applicable for configuration, commissioning and programming of CPX terminals
COB-ID	Communication object identifier; for every communication object, there is a unique COB-ID in the network
CODESYS	Controller Development System
CPX terminal	Modular terminal, available in different variants: – CPX...: Standard design with plastic linking – CPX-M: Standard design with metal linking – CPX-L: Standard design for control cabinet installation – CPX-P: Variant P, optimised for use in process automation
DIL switches	Miniature switches; dual-in-line switches usually consist of several switch elements which can be used to implement settings
$F0_h$	Hexadecimal numbers are marked by a low-set “h”
FEC	Front End Controller, e.g. CPX-FEC, can be used as: – stand-alone system controller (PLC, stand alone operating mode) – system controller (PLC, remote controller operating mode) – fieldbus slave (remote I/O operating mode)
Function module	Collective term for modules with additional functions, e.g. CP-interface, front end controller (CPX-FEC) and CODESYS controller (CPX-CEC); function modules are also known as technology modules
Handheld control unit (MMI)	Handheld terminal (handheld, CPX-MMI) for CPX modules for commissioning and service purposes (man-machine interface, MMI)
I/O diagnostic interface	The I/O diagnostic interface is a bus-independent diagnostic interface at I/O level that permits access to internal data of the CPX terminal
I/O modules	Collective term for the CPX modules which provide digital inputs and outputs

Term/abbreviation	Significance
I/Os	Digital inputs and outputs
IPC	Industrial PC
IW / OW	Input/output word
O, I	Digital output, digital input
PLC	Programmable logic controller, also designated fieldbus master, system controller or higher-order controller (➔ also PLC)
PLC	Programmable Logic Controller (German: Speicherprogrammierbare Steuerung (SPS))
Pneumatics interface	Interface between CPX modules and pneumatics modules
SCO SCS, SCO, SCV	Short circuit/overload Short circuit/overload sensor supply, outputs, valves
Status bits	Internal inputs which supply coded common diagnostic messages
Technology module	➔ Function module

Tab. 0/2: Product-specific terms and abbreviations

Installation

Chapter 1

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1.1 General instructions on installation

Warning
Danger of injury through uncontrolled movements of connected equipment.

Make sure that electrical and pneumatic equipment are in a de-energised and pressureless status.

Before working on the pneumatics:
- Switch off the compressed air supply
- Vent the valve terminal

Before working on the electrical components, e.g. before installation or maintenance work:
- Switch off the power supply

In this way, you can avoid:
– uncontrolled movements of loose tubing
– accidental and uncontrolled movements of the connected actuators
– undefined switching states of the electronics

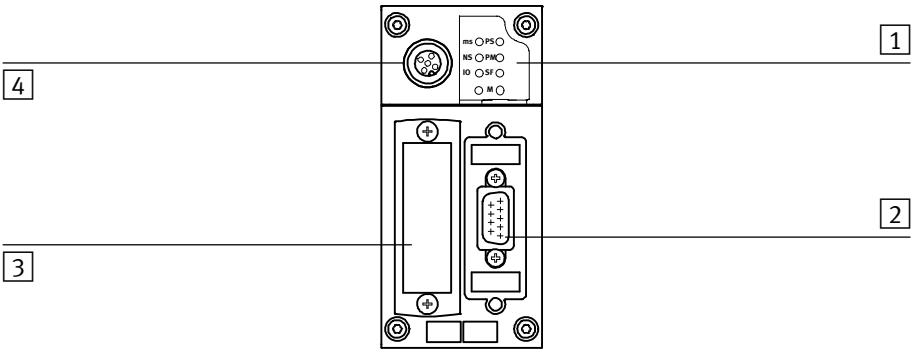
Note
The CPX bus node contains electrostatically sensitive devices.
- Do not touch any electrical or electronic components.
- Observe the handling specifications for electrostatically sensitive devices.

They will help you avoid damage to the electronics.

Information about mounting of the CPX terminal can be found in the CPX system description (P.BE-CPX-SYS-...).

Electrical connection and display components

The following connection and display components are found on the CPX bus node for CANopen:



1 Bus-status-specific and CPX-specific LEDs

2 Fieldbus connection (9-pin sub-D plug)

3 Transparent cover for the DIL switches

4 Service interface for handheld

Fig. 1/1: Connection and display components on the CPX bus node

Note
Use protective caps to seal unused connections. This is how you achieve protection class IP65/IP67.

Dismantling and mounting

The bus node is mounted in an interlinking block of the CPX terminal (➔ Fig. 1/2).

Dismantling

Dismantle the bus node as follows:

1. Loosen the 4 screws of the bus node with a Torx screwdriver size T10.
2. Pull the bus node carefully and without tilting away from the contact rails of the interlinking block.

1 Bus node CPX-FB14

2 Interlinking block

3 Contact rails

4 TORX T10 screws

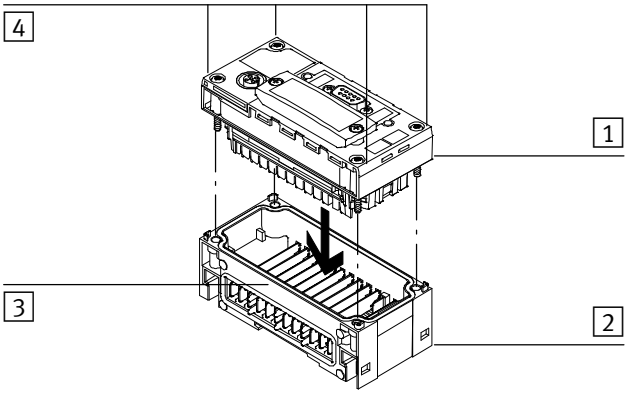


Fig. 1/2: Dismantling/mounting the bus node

➔

Note
Always use the correct screws for the interlocking block, which depend on whether the block is made of metal or plastic:

– for **plastic** interlinking blocks: self-tapping screws
– for **metal** interlinking blocks: screws with metric thread.

Both types of screws are enclosed respectively when the bus node is ordered as a single part.

Mounting

Mount the bus node as follows:

1. Check seal and seal surfaces.
2. Place the bus node in the interlinking block. Make sure that the corresponding grooves with the contacting terminals on the bottom of the bus node are above the contact rails.
3. Then push the bus node carefully and without tilting into the interlinking block up to the stop.
4. Only tighten the screws by hand. Place the screws so that the self-cutting threads can be used.
5. Tighten the screws with a TORX screwdriver size T10 with 0.9 ... 1.1 Nm torque.

1.2 Settings of the DIL switches on the bus node

In order to set the CPX bus node, you must first remove the cover for the DIL switches.

Note
The CPX bus node contains electrostatically sensitive devices.

- Do not touch any electrical or electronic components.
- Observe the handling specifications for electrostatically sensitive devices.

They will help you avoid damage to the electronics.

1.2.1 Removing and mounting the cover for the DIL switches

You need a screwdriver in order to remove or attach the cover.

Note
Observe the following instructions when removing or attaching the cover:

- Disconnect the power supply before removing the cover.
- Make sure that the seal is seated correctly when attaching the cover!
- Tighten the two mounting screws with a max. torque of 0.4 Nm.

1.2.2 Settingthe DIL switches

When the cover over the DIL switches is removed, you will see 5 DIL switches in the bus node (➔ Fig. 1/3).

You can set the following parameters with the DIL switches:

– Operating mode

– Error mode

– Station number/layer setting service

– Baud rate

– CPX diagnostics mode

Procedure:

1. Switch off the power supply.
2. Remove the cover over the DIL switches (section 1.2.1).
3. Set the desired operating mode (DIL switch 1, factory setting: remote I/O).
4. Set the error mode (DIL switch 2).
5. Assign to the CPX terminal a station number that is not yet allocated: Set the desired station number or activate layer setting services (8-off DIL switch 3, switch elements 1 ... 7).
6. Set the baud rate (DIL switch 4) if you have not activated layer setting services.
7. For remote I/O operating mode:
   Set the CPX diagnostic mode (DIL switch 5).

   For remote controller operating mode:
   Set the required number of logical I/Os of the CPX-FB14 (DIL switch 5).
8. Mount the cover (section 1.2.1).

1 DIL switch 1: operating mode

2 DIL switch 2: undervoltage error message mode

3 DIL switch 3: station number

4 DIL switch 4: baud rate

5 DIL switch 5: CPX diagnostics mode or number of log. I/Os with “remote controller”

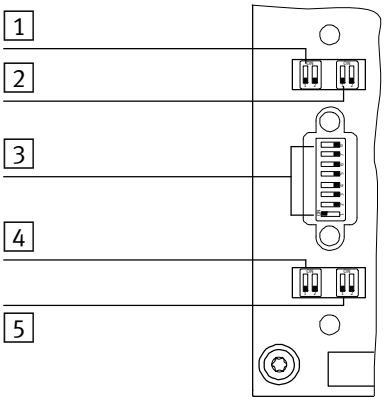


Fig. 1/3: DIL switch in the bus node
(additional information on 1 ... 5 in the following)

Setting the operating mode with DIL switch 1

You can set the operating mode of the bus node with switch element 1 of DIL switch 1:

Operating mode	Setting DIL switch 1	
Remote I/O operating mode All functions of the CPX terminal are controlled directly by the CANopen Master. An FEC or CEC that may be integrated into the CPX terminal works as a passive function module without controller.		DIL 1.1: OFF DIL 1.2: OFF (factory setting)
Remote controller operating mode An FEC or CEC integrated into the CPX terminal takes over I/O control. This operating mode is only useful if an FEC or CEC is integrated into the CPX terminal.		DIL 1.1: ON DIL 1.2: OFF

Tab. 1/1: DIL switch 1: (operating mode)

Setting the error mode with DIL switch 2

You set the error mode with switch element 1 of the dual DIL switch 2:

Error mode	Setting DIL switch 2	
Reporting undervoltage error		2.1: OFF (factory setting)
Filtering undervoltage error Errors during monitoring of the operating and load voltage supplies will be ignored		2.1: ON
Reserved		2.2: Always OFF

Tab. 1/2: DIL switch 2 (“Undervoltage” error message)

With the setting “Filter undervoltage error”, voltage errors which occur will not be reported as errors. In this way, you can, for example, suppress unnecessary error messages during the commissioning phase.

The setting of the DIL switch has precedence especially over the parameterisation of defined settings. No emergency message is transmitted with error filtering.

Setting of the station number with DIL switch 3

You can set the station number of the CPX terminal binary coded with the 8-off DIL switch 3:

1 Setting the station number (switch elements 1...7)

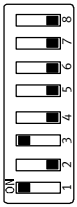
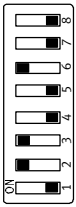
Fig. 1/4: DIL switch 3: (station number)

The following station numbers are permissible:

Protocol	Address designation	Permissible station numbers
CANopen	Station number	1; ...; 127

Tab. 1/3: Permissible station numbers

Recommendation:
Assign the station numbers in ascending order. Assign the station numbers in accordance with the machine structure of your system.

Example: Station number set: 05	Example: Station number set: 38
 $2^0 + 2^2 =$ $1 + 4 =$ 5	 $2^1 + 2^2 + 2^5 =$ $2 + 4 + 32 =$ 38

Tab. 1/4: Examples of set station numbers (binary coded)

On the following pages you will find an overview of the station number settings.

Station no.	1	2	3	4	5	6	7	8	Station no.	1	2	3	4	5	6	7	8
0	Activation of LSS (from software version V1.26)								**16**	OFF	OFF	OFF	OFF	ON	OFF	OFF	
1	ON	OFF	OFF	OFF	OFF	OFF	OFF		**17**	ON	OFF	OFF	OFF	ON	OFF	OFF	
2	OFF	ON	OFF	OFF	OFF	OFF	OFF		**18**	OFF	ON	OFF	OFF	ON	OFF	OFF	
3	ON	ON	OFF	OFF	OFF	OFF	OFF		**19**	ON	ON	OFF	OFF	ON	OFF	OFF	
4	OFF	OFF	ON	OFF	OFF	OFF	OFF		**20**	OFF	OFF	ON	OFF	ON	OFF	OFF	
5	ON	OFF	ON	OFF	OFF	OFF	OFF		**21**	ON	OFF	ON	OFF	ON	OFF	OFF	
6	OFF	ON	ON	OFF	OFF	OFF	OFF		**22**	OFF	ON	ON	OFF	ON	OFF	OFF	
7	ON	ON	ON	OFF	OFF	OFF	OFF		**23**	ON	ON	ON	OFF	ON	OFF	OFF	
8	OFF	OFF	OFF	ON	OFF	OFF	OFF		**24**	OFF	OFF	OFF	ON	ON	OFF	OFF	
9	ON	OFF	OFF	ON	OFF	OFF	OFF		**25**	ON	OFF	OFF	ON	ON	OFF	OFF	
10	OFF	ON	OFF	ON	OFF	OFF	OFF		**26**	OFF	ON	OFF	ON	ON	OFF	OFF	
11	ON	ON	OFF	ON	OFF	OFF	OFF		**27**	ON	ON	OFF	ON	ON	OFF	OFF	
12	OFF	OFF	ON	ON	OFF	OFF	OFF		**28**	OFF	OFF	ON	ON	ON	OFF	OFF	
13	ON	OFF	ON	ON	OFF	OFF	OFF		**29**	ON	OFF	ON	ON	ON	OFF	OFF	
14	OFF	ON	ON	ON	OFF	OFF	OFF		**30**	OFF	ON	ON	ON	ON	OFF	OFF	
15	ON	ON	ON	ON	OFF	OFF	OFF		**31**	ON	ON	ON	ON	ON	OFF	OFF	

Tab. 1/5: Setting of the station numbers 1 ... 31: position of the DIL switch

Station no.	1	2	3	4	5	6	7	8	Station no.	1	2	3	4	5	6	7	8
32	OFF	OFF	OFF	OFF	OFF	ON	OFF		**48**	OFF	OFF	OFF	OFF	ON	ON	OFF	
33	ON	OFF	OFF	OFF	OFF	ON	OFF		**49**	ON	OFF	OFF	OFF	ON	ON	OFF	
34	OFF	ON	OFF	OFF	OFF	ON	OFF		**50**	OFF	ON	OFF	OFF	ON	ON	OFF	
35	ON	ON	OFF	OFF	OFF	ON	OFF		**51**	ON	ON	OFF	OFF	ON	ON	OFF	
36	OFF	OFF	ON	OFF	OFF	ON	OFF		**52**	OFF	OFF	ON	OFF	ON	ON	OFF	
37	ON	OFF	ON	OFF	OFF	ON	OFF		**53**	ON	OFF	ON	OFF	ON	ON	OFF	
38	OFF	ON	ON	OFF	OFF	ON	OFF		**54**	OFF	ON	ON	OFF	ON	ON	OFF	
39	ON	ON	ON	OFF	OFF	ON	OFF		**55**	ON	ON	ON	OFF	ON	ON	OFF	
40	OFF	OFF	OFF	ON	OFF	ON	OFF		**56**	OFF	OFF	OFF	ON	ON	ON	OFF	
41	ON	OFF	OFF	ON	OFF	ON	OFF		**57**	ON	OFF	OFF	ON	ON	ON	OFF	
42	OFF	ON	OFF	ON	OFF	ON	OFF		**58**	OFF	ON	OFF	ON	ON	ON	OFF	
43	ON	ON	OFF	ON	OFF	ON	OFF		**59**	ON	ON	OFF	ON	ON	ON	OFF	
44	OFF	OFF	ON	ON	OFF	ON	OFF		**60**	OFF	OFF	ON	ON	ON	ON	OFF	
45	ON	OFF	ON	ON	OFF	ON	OFF		**61**	ON	OFF	ON	ON	ON	ON	OFF	
46	OFF	ON	ON	ON	OFF	ON	OFF		**62**	OFF	ON	ON	ON	ON	ON	OFF	
47	ON	ON	ON	ON	OFF	ON	OFF		**63**	ON	ON	ON	ON	ON	ON	OFF	

Tab. 1/6: Setting of the station numbers 32 ... 63: position of the DIL switch

Station no.	1	2	3	4	5	6	7	8	Station no.	1	2	3	4	5	6	7	8
64	OFF	OFF	OFF	OFF	OFF	OFF	ON		**80**	OFF	OFF	OFF	OFF	ON	OFF	ON	
65	ON	OFF	OFF	OFF	OFF	OFF	ON		**81**	ON	OFF	OFF	OFF	ON	OFF	ON	
66	OFF	ON	OFF	OFF	OFF	OFF	ON		**82**	OFF	ON	OFF	OFF	ON	OFF	ON	
67	ON	ON	OFF	OFF	OFF	OFF	ON		**83**	ON	ON	OFF	OFF	ON	OFF	ON	
68	OFF	OFF	ON	OFF	OFF	OFF	ON		**84**	OFF	OFF	ON	OFF	ON	OFF	ON	
69	ON	OFF	ON	OFF	OFF	OFF	ON		**85**	ON	OFF	ON	OFF	ON	OFF	ON	
70	OFF	ON	ON	OFF	OFF	OFF	ON		**86**	OFF	ON	ON	OFF	ON	OFF	ON	
71	ON	ON	ON	OFF	OFF	OFF	ON		**87**	ON	ON	ON	OFF	ON	OFF	ON	
72	OFF	OFF	OFF	ON	OFF	OFF	ON		**88**	OFF	OFF	OFF	ON	ON	OFF	ON	
73	ON	OFF	OFF	ON	OFF	OFF	ON		**89**	ON	OFF	OFF	ON	ON	OFF	ON	
74	OFF	ON	OFF	ON	OFF	OFF	ON		**90**	OFF	ON	OFF	ON	ON	OFF	ON	
75	ON	ON	OFF	ON	OFF	OFF	ON		**91**	ON	ON	OFF	ON	ON	OFF	ON	
76	OFF	OFF	ON	ON	OFF	OFF	ON		**92**	OFF	OFF	ON	ON	ON	OFF	ON	
77	ON	OFF	ON	ON	OFF	OFF	ON		**93**	ON	OFF	ON	ON	ON	OFF	ON	
78	OFF	ON	ON	ON	OFF	OFF	ON		**94**	OFF	ON	ON	ON	ON	OFF	ON	
79	ON	ON	ON	ON	OFF	OFF	ON		**95**	ON	ON	ON	ON	ON	OFF	ON	

Tab. 1/7: Setting of the station numbers 64 ... 95: position of the DIL switch

Station no.	1	2	3	4	5	6	7	8	Station no.	1	2	3	4	5	6	7	8
96	OFF	OFF	OFF	OFF	OFF	ON	ON		**112**	OFF	OFF	OFF	OFF	ON	ON	ON	
97	ON	OFF	OFF	OFF	OFF	ON	ON		**113**	ON	OFF	OFF	OFF	ON	ON	ON	
98	OFF	ON	OFF	OFF	OFF	ON	ON		**114**	OFF	ON	OFF	OFF	ON	ON	ON	
99	ON	ON	OFF	OFF	OFF	ON	ON		**115**	ON	ON	OFF	OFF	ON	ON	ON	
100	OFF	OFF	ON	OFF	OFF	ON	ON		**116**	OFF	OFF	ON	OFF	ON	ON	ON	
101	ON	OFF	ON	OFF	OFF	ON	ON		**117**	ON	OFF	ON	OFF	ON	ON	ON	
102	OFF	ON	ON	OFF	OFF	ON	ON		**118**	OFF	ON	ON	OFF	ON	ON	ON	
103	ON	ON	ON	OFF	OFF	ON	ON		**119**	ON	ON	ON	OFF	ON	ON	ON	
104	OFF	OFF	OFF	ON	OFF	ON	ON		**120**	OFF	OFF	OFF	ON	ON	ON	ON	
105	ON	OFF	OFF	ON	OFF	ON	ON		**121**	ON	OFF	OFF	ON	ON	ON	ON	
106	OFF	ON	OFF	ON	OFF	ON	ON		**122**	OFF	ON	OFF	ON	ON	ON	ON	
107	ON	ON	OFF	ON	OFF	ON	ON		**123**	ON	ON	OFF	ON	ON	ON	ON	
108	OFF	OFF	ON	ON	OFF	ON	ON		**124**	OFF	OFF	ON	ON	ON	ON	ON	
109	ON	OFF	ON	ON	OFF	ON	ON		**125**	ON	OFF	ON	ON	ON	ON	ON	
110	OFF	ON	ON	ON	OFF	ON	ON		**126**	OFF	ON	ON	ON	ON	ON	ON	
111	ON	ON	ON	ON	OFF	ON	ON		**127**	ON	ON	ON	ON	ON	ON	ON	

Tab. 1/8: Setting of the station numbers 96 ... 127: position of the DIL switch

Activation of the layer setting service (LSS) with DIL switch 3

The bus node CPX-FB14 supports layer setting service (LSS) in accordance with CiA DSP-305.

With the help of the layer setting service (LSS), the LSS master can change the baud rate and node number of an LSS slave via the CANopen bus.

You activate LSS with the 8-off DIL switch 3.

- To do this, set the switch elements 1 ... 7 of the DIL switch 3 to OFF (station number = 0).

1 Activate LSS (switch elements 1 ... 7)

Fig. 1/5: DIL switch 3 (station number)

Resetting parameters with DIL switch 3

The bus node can be reset to factory setting with switch element 8 of the DIL switch 3.

The power supply of the CPX terminal is switched off.

1. Set the switch element 8 of the DIL switch 3 to ON.
2. Switch on the power supply for the CPX terminal (Power on).

The bus node is reset to factory settings during boot-up.

3. Set the switch element 8 of the DIL switch 3 back to OFF.

Setting the baud rate with DIL switch 4

You can set the baud rate with the dual DIL switch 4:

Baud rate	Setting DIL switch 4	
125 kB		4.1: OFF 4.2: OFF (factory setting)
250 kB		4.1: ON 4.2: OFF
500 kB		4.1: OFF 4.2: ON
1000 kB		4.1: ON 4.2: ON

Tab. 1/9: DIL switch 4 (baud rate)

The following table shows the settings of the DIL switch.

Setting the diagnostics mode or the number of logical I/Os (data field size) with DIL switch 5

The function of DIL switch 5 is dependent on the set operating mode of the CPX terminal (➔ Tab. 1/1):

– Remote I/O operating mode:
setting the CPX diagnostic mode.
The status bits occupy 8 bits and the I/O diagnostic interface 16 bits in PDO 4 (bit 0 ... 7 or 0 ... 15, ➔ Fig. 2/1).

– Remote controller operating mode:
64 I/Os are provided for communication of the bus node with the FEC/CEC in PDO 1 (➔ Fig. 2/2).

Remote I/O operating mode **Diagnostics mode**	**Remote controller operating mode** **Number of I/O bytes (data field size)**	**Setting DIL switch 5**	
I/O diagnostics interface and status bits are switched off (+ 0 I/O bits)	Reserved for future extensions		3.1: OFF 3.2: OFF (factory setting)
The status bits are switched on 1) (+ 8 (16) I bits)			3.1: OFF 3.2: ON
I/O diagnostics interface is switched on 1) (+ 16 I/O bits)			3.1: ON 3.2: OFF
Reserved for future extensions	**8 bytes I/8 bytes O** for communication of the bus node with the CPX-FEC or CPX-CEC		3.1: ON 3.2: ON
1) The diagnostics mode (status bits or I/O diagnostics interface) occupies 2 bytes or 4 bytes of address space (16 I-bits or 16 I/O-bits; 8 I-bits remain unused in the status bits mode)			

Tab. 1/10: DIL switch 5 (diagnostics mode or number of I/O bytes with remote controller)

Note

(1) An activated diagnostics mode reduces the available address space in the PDO 4

Use of the diagnostics mode (status bits or I/O diagnostic interface) occupies **16 I** or **16 I/O bits** in the PDO 4. In combination with technology modules, it thus reduces the number of I/O bits which are available for module communication. In this way, the number of addressable modules is reduced in favour of additional status or diagnostic information.

Take account of this fact for the planning of your CPX terminal.

(2) Subsequent activation of the diagnostics mode requires reconfiguration

The CPX-internal I/O image can be displaced during subsequent activation of the diagnostics mode (status bits or I/O diagnostics interface). Restart the CPX terminal with Power OFF/ON.

1.3 Connecting the fieldbus

1.3.1 Fieldbus cable

Note
Faulty installation and high transmission rates may cause data transmission errors as a result of signal reflections and attenuations.
Causes of the transmission errors can be:
– missing or incorrect terminating resistor
– incorrect screened connection
– branches
– transmission over long distances
– inappropriate cables.
Observe the cable specifications! Refer to the manual for your control system for information on the type of cable to be used.

Use a twisted, screened 4-wire cable as fieldbus line. The CANopen bus interface of the CPX terminal is supplied with power via the fieldbus line.

If the Festo fieldbus plug is used, a cable diameter of 5...8 mm or 7...10 mm is permissible.

Note
If the CPX terminal is mounted movably into a machine, the fieldbus cable on the movable part must be provided with strain relief. Also observe the corresponding regulations in EN 60204 Part 1.

1.3.2 Fieldbus baud rate and fieldbus length

The maximum permissible fieldbus length and length of the branch lines depends on the baud rate used. Detailed specifications can be found in the manuals for the your control system or bus interface.

Note

- Refer to the manuals for your control system or bus interface in order to ascertain which T-adapter and maximum branch line length are permitted for your controller.
- Also take into account the sum of the branch line lengths when calculating the maximum permitted length of the fieldbus cable.

1.3.3 Information on connecting the fieldbus

Bus power supply

Avoid long distances between the bus interface supply and the CPX terminal.

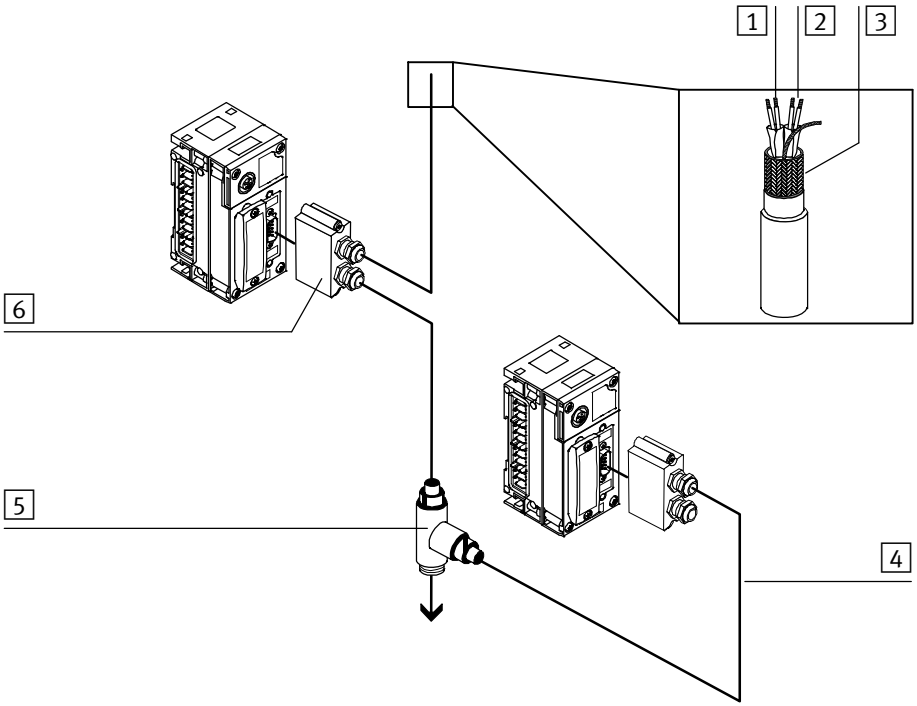
Caution
- Make sure the polarity is correct when you connect the fieldbus interface and the power supply for the bus interface/internal logic.
- Protect the voltage supply to the bus interface externally, corresponding to the number of stations on the bus.
- Connect the screening.

Note
Power supply is needed over the fieldbus line (pin 3 and pin 9 on the Sub-D plug).
Bus stations have different tolerances regarding interface supply, dependent on the manufacturer. Observe this when designing the bus length and placing the power supply unit.

The following tolerance in the bus interface power supply (pin 3/pin 9 on the sub-D plug) applies to the CPX terminal:
U_{max} = 30.0 V
U_{min} = 11.0 V

Recommendation:
Place the power supply unit approximately at the centre of the bus.

With the Festo fieldbus plug, you can implement a T-adapter (➔ Fig. 1/6).



1 Fieldbus
2 Voltage supply
3 Screening
4 Branch line
5 T-adapter (T-tap)
6 Fieldbus plug with T-adapter function

Fig. 1/6: Structure of the bus interface and example of connection

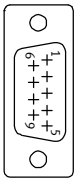
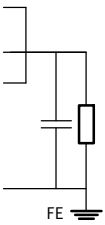
1.3.4 Fieldbus interface

There is 9-pin sub-D plug on the bus node for connecting the CPX terminal to the fieldbus. This connection is used for the incoming and continuing fieldbus line. You can connect the CPX terminal with the fieldbus plug from Festo type FBS-SUB-9-BU-2x5POL-B.

Note
Note that only the Festo fieldbus plug guarantees compliance with protection class IP65.

Before using fieldbus plugs from other manufacturers:

- Replace the two flat screws with bolts (type UNC4-40/M3x6).

Plug on the CPX terminal	Pin	Internal contacting	CANopen	Designation
	1		n.c.	not connected
	2		**CAN_L**	CAN bus low
	3		**CAN_GND**	Power supply to bus (0 V)
	4		n.c.	not connected
	5		CAN_SHLD	Connection to functional earth (screening)
	6		GND	Optional GND
	7		**CAN_H**	CAN bus high
	8		n.c.	not connected
	9		**CAN_V+**	Power supply to bus (24 V)
	Housing (plug)			

Tab. 1/11: Pin assignment of the fieldbus interface of the CPX bus node

1.3.5 Connecting with the fieldbus plug from Festo

Note
Use protective caps or blanking plugs to seal unused connections. You will then achieve protection class IP65.

- Observe the assembly instructions for the fieldbus plug. Tighten the two fastening screws at first by hand and then with max. 0.4 Nm!

With the fieldbus plug from Festo (FBS-SUB-9-BU-2x5POL-B), you can connect the CPX terminal easily to the fieldbus. You can disconnect the plug from the node without interrupting the bus line (T-TAP function).

Note
The clamp strap in the Festo fieldbus plug is connected only capacitively internally with the metal housing of the sub-D socket. This prevents equalizing currents from flowing via the screening of the fieldbus cable (Fig. 1/7).

- Clamp the screening of the fieldbus cable under the clamp strap in the fieldbus plug.

1 Folding cover with inspection window

2 Clamp strap for screened connection

3 Protective cap if connection is not used

4 Fieldbus continuing (OUT)

5 Fieldbus incoming (IN)

6 Only capacitively connected

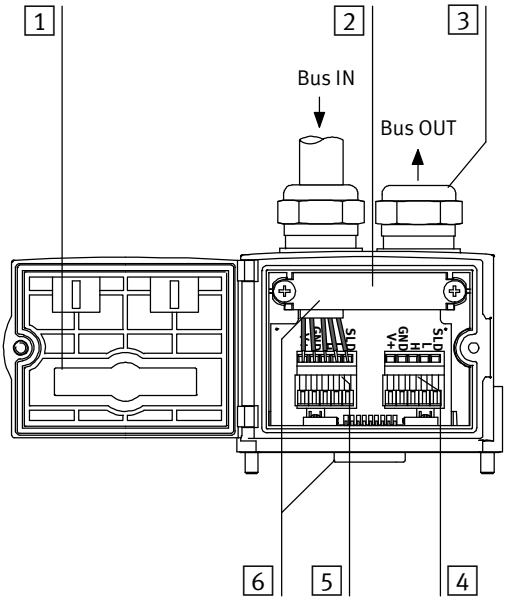


Fig. 1/7: Fieldbus plug from Festo, type FBS-SUB-9-BU-2x5POL-B

1.3.6 Further connection possibilities for the fieldbus with adapters

Caution
- When connecting the fieldbus interface and the power supply for the bus interface, pay attention to the polarity.
- Connect the screening.

There are further connection options for the CPX terminal with adapters which can be ordered separately from Festo:

– M12 adapter 5-pin (protection class IP 65)
type FBA-2-M12-5POL

– Screw terminal adapter 5-pin (protection class IP20)
type FBA-1-SL-5POL

M12 adapter (IP65)

With this adapter the bus is connected via a 5-pin M12 socket with PG9 fitting. Use the second connection socket for continuation of the fieldbus.

Note
- Use protective caps to seal unused connections.

You will then achieve protection class IP65.

Order this connection from Festo (FBA-2-M12-5POL).

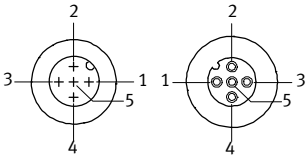
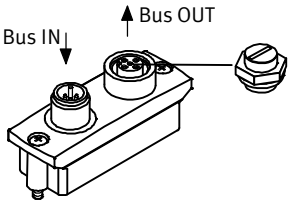
M12 adapter	**Pin no.**
	1. Screening 2. 24 V DC bus (max. 4 A) 3. 0 V bus 4. CAN_H 5. CAN_L
 Protective cap or plug with bus termination resistor if connection is not used.	

Fig. 1/8: Pin assignment of the fieldbus interface (adapter for 5-pin M12 connection)

With the two M12 connections, you can implement a T-adapter (➔ Fig. 1/6).

Screw terminal adapter (IP20)

With this adapter the bus is connected to a 2x5-pin terminal strip. Use the second row of connections for the continuing fieldbus.
The maximum permissible current at the clamps is 4 A. Use cables with a minimum cross-section of 0.34 mm^2.

Order this connection from Festo (FBA-1-SL-5POL) together with the terminal strip type FBSD-KL-2x5POL.

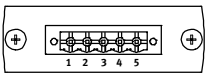
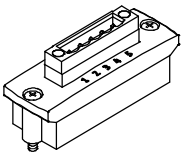
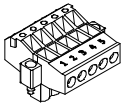
Screw terminal adapter	**Pin no.**
	1. 0 V bus 2. CAN_L 3. Screening 4. CAN_H 5. 24 V DC bus (max. 4 A)
  2x5-pin terminal strip	

Fig. 1/9: Pin assignment of the fieldbus interface (5-pin screw terminal adapter)

If you connect the fieldbus via the terminal strip FBSD-KL-2x5POL from Festo, you can implement a T-adapter function.

1.4 Bus terminal with terminating resistors

Note
Always use a terminating resistor at both ends of the fieldbus. This also applies if the CPX terminal is at the end of the fieldbus.

If you are using T-adapters, install the terminating resistor at the unused output of the T-adapter.

Recommendation: Mount a terminating resistor for the bus terminal in the Festo fieldbus plug (120 Ω, 0,25 W, ➔ Fig. 1/10).

1 Protective cap

2 Resistor for bus termination (120 Ω, 0.25 W)

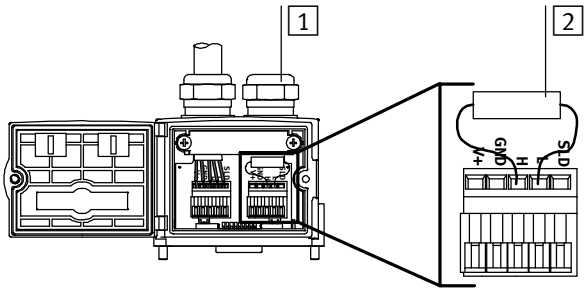


Fig. 1/10: Terminating resistor in the fieldbus plug from Festo

1.4.1 Install a terminating resistor using the adapters

If the CPX terminal to be connected is at the end of the fieldbus, a terminating resistor (120 Ω, 0.25 W) must be installed in the fieldbus socket.

- Connect the terminating resistor between the cores for CAN_H and CAN_L.

1.5 Power supply

Warning
- Only use PELV circuits in accordance with IEC/EN 60204-1 (protective extra-low voltage, PELV) for the electrical power supply.
- Consider also the general requirements for PELV circuits in accordance with IEC/EN 60204-1.
- Only use voltage sources which ensure reliable electrical isolation of the operating voltage in accordance with IEC/EN 60204-1.

Through the use of PELV circuits, protection from electric shock (protection from direct and indirect contact) in accordance with IEC/DIN EN 60204-1 is ensured (Electrical equipment of machines. General requirements).

The current consumption of a CPX terminal depends on the number and type of integrated modules and components.

Read in the CPX system description the information on power supply as well as on the earthing measures to be carried out.

System power supply, additional power supply and valve power supply

The CPX terminal is supplied with operating and load power via the interlinking block with system, additional and valve supply.

The pin allocation of the CPX interlinking blocks can be found in the CPX system description and the package insert for the CPX interlinking block.

Commissioning

Chapter 2

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2.1 Commissioning on a CANopen master

This section describes the configuration and addressing of a CPX terminal on a CANopen interface or CANopen master.

The following specifications have been taken into account:

CANopen specifications	
CiA 201, V1.1.0 CiA 207	CAN application layer CAL
CiA 301, V4.2.0	The specification CiA 301 relies on the CAL-based communication profile
CiA 305 DSP V2.2	The Draft Standard Proposal describes the layer setting service (LSS)
CiA 401, V3.0.0	The specification CiA 401 defines the device profiles for input and output modules within CANopen

Tab. 2/1: CANopen specifications taken into account with the CPX terminal

In order to understand this chapter, you should be familiar with CANopen and the specifications CiA 301, CIA DSP 305 and CiA 401.

2.1.1 General information on CANopen

CANopen devices have an object directory which makes all important participant parameters accessible in a standardized manner. A CANopen system is configured mainly by access to the object directory of the individual participants. The access mechanism is provided by Service Data Objects (SDOs).

There are two different communication mechanisms in a CANopen system.

Process Data Objects (PDOs) provide fast transfer of process data and are transmitted by simple CAN messages with no protocol overhead. Process Data Objects may be transmitted based on event control, synchronised to a system clock, or on request.

The **Service Data Objects** (SDO) form a point-to-point connection and permit access to every entry in the object directory of a node.

2.2 Configuration

2.2.1 Layer setting service (LSS)

With the help of the layer setting service (LSS), an LSS master can change the baud rate and station number (node number) of an LSS slave via the CAN bus. Communication between the LSS master and LSS slave takes place via the LSS protocol.

The LSS slave is identified through its LSS address.

An LSS address, according to CiA DSP-305, consists of:

– Vendor ID

– Product code

– Revision number

– Serial number

To activate the layer setting service at the bus node CPX-FB38, the switch elements 1 ... 7 of the DIL switch 3 must be set to OFF (➔ Fig. 1/5).

LSS can only be used if the LSS slave is in the status “stopped” or “pre-operational”.

2.2.2 LSS commands

The LSS commands are sent from the LSS master with COB-ID 0x7E5 (communication object identifier). The LSS slave answers with COB-ID 0x7E4.

To make the bus node CPX-FB14 configurable via LSS, it must be placed in the LSS configuration mode. There are two different possibilities for this:

– Global mode change

– Selective mode change

Global mode change

With the “switch mode global” command, the LSS master switches the mode of the LSS slave.

COB-ID	Command								
0x7E5	Byte	0	1	2	3	4	5	6	7
	Data	0x04	Mode	0x00	0x00	0x00	0x00	0x00	0x00

Tab. 2/2: Switch mode global

Mode:

– 0x01 Switches the LSS slave into the configuration mode

– 0x00 Switches the LSS slave into the normal mode (operation mode)

The “switch mode global” command is not confirmed by the LSS slave.

Selective mode change

With the selective mode change, a specific LSS slave can be selected. To do this, a sequence of four commands is sent out by the LSS master.

Selective module change commands		Description	Contents (hex.)
1.	Vendor ID	Manufacturer ID (assigned by CiA)	00 00 00 1D
2.	Product code	Product code	00 00 00 CD
3.	Revision number	Software version	xx xx xx xx
4.	Serial number	Serial number	xx xx xx xx

Tab. 2/3: Selective mode change

1) Selective mode change – vendor ID

With the “switch mode selective – vendor ID” command, only the mode of the LSS slave with the specified vendor ID is changed.

COB-ID	Command								
0x7E5	Byte	0	1	2	3	4	5	6	7
	Data	0x40	VendorID	0x00	0x00	0x00	0x00	0x00	0x00

Tab. 2/4: Switch mode selective – vendor ID

The “switch mode selective – vendor ID” command is not confirmed by the LSS slave.

2) Selective mode change – product code

With the “switch mode selective – product code” command, only the mode of the LSS slave with the specified product code is changed.

COB-ID	Command								
0x7E5	Byte	0	1	2	3	4	5	6	7
	Data	0x41	ProdCode	0x00	0x00	0x00	0x00	0x00	0x00

Tab. 2/5: Switch mode selective – product code

The “switch mode selective – product code” command is not confirmed by the LSS slave.

3) Selective mode change – revision number

With the “switch mode selective – revision number” command, only the mode of the LSS slave with the specified revision number is changed.

COB-ID	Command								
0x7E5	Byte	0	1	2	3	4	5	6	7
	Data	0x42	Revision	0x00	0x00	0x00	0x00	0x00	0x00

Tab. 2/6: Switch mode selective – revision number

The “switch mode selective – revision number” command is not confirmed by the LSS slave.

4) Selective mode change – serial number

With the “switch mode selective – serial number” command, only the mode of the LSS slave with the specified serial number is changed.

COB-ID	Command								
0x7E5	Byte	0	1	2	3	4	5	6	7
	Data	0x43	Serial	0x00	0x00	0x00	0x00	0x00	0x00

Tab. 2/7: Switch mode selective – serial number

After the fourth command is sent, the addressed LSS slave answers (vendor ID, product code, revision number and serial number must agree with the internal data of the LSS slave).

COB-ID	Acknowledge								
0x7E4	Byte	0	1	2	3	4	5	6	7
	Data	0x44	Mode	0x00	0x00	0x00	0x00	0x00	0x00

Tab. 2/8: Answer to switch mode selective – serial number

Mode:

– 0x01 Configuration mode

– 0x00 Normal mode (operation mode)

Configure node number

With the “configure node ID” command, a new node number is assigned to the LSS slave.

COB-ID	Command								
0x7E5	Byte	0	1	2	3	4	5	6	7
	Data	0x11	Node ID	0x00	0x00	0x00	0x00	0x00	0x00

Tab. 2/9: Configure node ID

Node ID:

– Node ID of the LSS slave (possible values 1 ... 127)

COB-ID	Acknowledge								
0x7E4	Byte	0	1	2	3	4	5	6	7
	Data	0x11	Error code	Error extension	0x00	0x00	0x00	0x00	0x00

Tab. 2/10: Answer to configure node ID

Error code:

– 0 Successful assignment of the node ID

– 1 Impermissible node ID

– 0xFF Not all switch elements 1 ... 7 of the DIP switch 3 are at OFF. The bus node is not in the LSS mode.

Error extension:

– Reserved

Configure bit timing parameters

With the “configure bit timing parameters” command, a new baud rate is assigned to the LSS slave.

COB-ID	Command								
0x7E5	Byte	0	1	2	3	4	5	6	7
	Data	0x13	Bit timing table	Table entry	0x00	0x00	0x00	0x00	0x00

Tab. 2/11: Configure bit timing parameters

Bit timing table:

– Is always 0.

Table entry:

– 0 1000 kBaud

– 2 500 kBaud

– 3 250 kBaud

– 4 125 kBaud

COB-ID	Acknowledge								
0x7E4	Byte	0	1	2	3	4	5	6	7
	Data	0x13	Error code	Error extension	0x00	0x00	0x00	0x00	0x00

Tab. 2/12: Answer to configure bit timing parameters

Error code:

– 0 Successful assignment of the baud rate

– 1 Impermissible baud rate (baud rate is not supported)

– 0xFF Not all switch elements 1 ... 7 of the DIP switch 3 are at OFF. The bus node is not in the LSS mode.

Error extension:

– Reserved

Activate bit timing

With the “activate bit timing” command, the new baud rate is activated after a time delay.

This command can only be used in the configuration mode.

COB-ID	**Command**								
0x7E5	Byte	0	1	2	3	4	5	6	7
	Data	0x15	Delay	0x00	0x00	0x00	0x00	0x00	0x00

Tab. 2/13: Activate bit timing

Delay:

– Time delay in ms

The command is not confirmed by the LSS slave.

Save the configuration

With the “store configuration” command, the new node ID and the new baud rate are stored.

This command is only possible in the configuration mode.

COB-ID	Command								
0x7E5	Byte	0	1	2	3	4	5	6	7
	Data	0x17	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Tab. 2/14: Store configuration

COB-ID	Acknowledge								
0x7E4	Byte	0	1	2	3	4	5	6	7
	Data	0x17	Error code	Error extension	0x00	0x00	0x00	0x00	0x00

Tab. 2/15: Answer to store configuration

Error code:

- 0 Successful saving of the settings
- 1 Saving is not supported by the LSS slave.
- 2 No access to the storage medium.
- 0xFF Not all switch elements 1 ... 7 of the DIP switch 3 are at OFF. The bus node is not in the LSS mode.

Error extension:

- Reserved

Query manufacturer ID

With the “inquire vendor ID” command, the manufacturer ID of the LSS slave is queried.

COB-ID	**Command**								
0x7E5	Byte	0	1	2	3	4	5	6	7
	Data	0x5A	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Tab. 2/16: Inquire vendor ID

COB-ID	**Acknowledge**								
0x7E4	Byte	0	1	2	3	4	5	6	7
	Data	0x5A	Low word Low byte	Low word High byte	High word Low byte	High word High byte	0x00	0x00	0x00

Tab. 2/17: Answer to inquire vendor ID

Query product code

With the “inquire product code” command, the product code of the LSS slave is queried.

COB-ID	Command								
0x7E5	Byte	0	1	2	3	4	5	6	7
	Data	0x5B	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Tab. 2/18: Inquire product code

COB-ID	Acknowledge								
0x7E4	Byte	0	1	2	3	4	5	6	7
	Data	0x5B	Low word Low byte	Low word High byte	High word Low byte	High word High byte	0x00	0x00	0x00

Tab. 2/19: Answer to inquire product code

Query revision number

With the “inquire revision number” command, the revision number of the LSS slave is queried.

COB-ID	Command								
0x7E5	Byte	0	1	2	3	4	5	6	7
	Data	0x5C	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Tab. 2/20: Inquire revision number

COB-ID	Acknowledge								
0x7E4	Byte	0	1	2	3	4	5	6	7
	Data	0x5C	Low word Low byte	Low word High byte	High word Low byte	High word High byte	0x00	0x00	0x00

Tab. 2/21: Answer to inquire revision number

Query serial number

With the “inquire serial number” command, the serial number of the LSS slave is queried.

COB-ID	Command								
0x7E5	Byte	0	1	2	3	4	5	6	7
	Data	0x5D	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Tab. 2/22: Inquire serial number

COB-ID	Acknowledge								
0x7E4	Byte	0	1	2	3	4	5	6	7
	Data	0x5D	Low word Low byte	Low word High byte	High word Low byte	High word High byte	0x00	0x00	0x00

Tab. 2/23: Answer to inquire serial number

Query node number

With the “inquire node ID” command, the currently set node number of the LSS slave is queried.

COB-ID	Command								
0x7E5	Byte	0	1	2	3	4	5	6	7
	Data	0x5E	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Tab. 2/24: Inquire node ID

COB-ID	Acknowledge								
0x7E4	Byte	0	1	2	3	4	5	6	7
	Data	0x5E	Node ID	0x00	0x00	0x00	0x00	0x00	0x00

Tab. 2/25: Answer to inquire node ID

Identify manufacturer's code

With the "identify vendor ID" command, the manufacturer ID of the LSS slave is identified.

COB-ID	Command								
0x7E5	Byte	0	1	2	3	4	5	6	7
	Data	0x46	Low word Low byte	Low word High byte	High word Low byte	High word High byte	0x00	0x00	0x00

Tab. 2/26: Identify vendor ID

The command is not confirmed by the LSS slave.

Identify product code

With the "identify product code" command, the product code of the LSS slave is identified.

COB-ID	Command								
0x7E5	Byte	0	1	2	3	4	5	6	7
	Data	0x47	Low word Low byte	Low word High byte	High word Low byte	High word High byte	0x00	0x00	0x00

Tab. 2/27: Identify product code

The command is not confirmed by the LSS slave.

Identify revision number (low)

With the “identify revision number low” command, the lower limit of the LSS slave’s revision number is identified.

COB-ID	Command								
0x7E5	Byte	0	1	2	3	4	5	6	7
	Data	0x48	Low word Low byte	Low word High byte	High word Low byte	High word High byte	0x00	0x00	0x00

Tab. 2/28: Identify revision number low

The command is not confirmed by the LSS slave.

Identify revision number (high)

With the “identify revision number high” command, the upper limit of the LSS slave’s revision number is identified.

COB-ID	Command								
0x7E5	Byte	0	1	2	3	4	5	6	7
	Data	0x49	Low word Low byte	Low word High byte	High word Low byte	High word High byte	0x00	0x00	0x00

Tab. 2/29: Identify revision number high

The command is not confirmed by the LSS slave.

Identify serial number (low)

With the “identify serial number low” command, the lower limit of the LSS slave’s revision number is identified.

COB-ID	Command								
0x7E5	Byte	0	1	2	3	4	5	6	7
	Data	0x4A	Low word Low byte	Low word High byte	High word Low byte	High word High byte	0x00	0x00	0x00

Tab. 2/30: Identify serial number low

The command is not confirmed by the LSS slave.

Identify serial number (high)

With the “identify serial number high” command, the upper limit of the LSS slave’s revision number is identified.

COB-ID	Command								
0x7E5	Byte	0	1	2	3	4	5	6	7
	Data	0x4B	Low word Low byte	Low word High byte	High word Low byte	High word High byte	0x00	0x00	0x00

Tab. 2/31: Identify serial number high

COB-ID	Acknowledge								
0x7E4	Byte	0	1	2	3	4	5	6	7
	Data	0x4F	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Tab. 2/32: Answer to Identify serial number high

Identify non-configured slave

With the “identify non-configured slave” command, a non-configured LSS slave is identified.

COB-ID	Command								
0x7E5	Byte	0	1	2	3	4	5	6	7
	Data	0x4C	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Tab. 2/33: Identify non-configured slave

COB-ID	Acknowledge								
0x7E4	Byte	0	1	2	3	4	5	6	7
	Data	0x50	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Tab. 2/34: Answer to identify non-configured slave

2.2.3 Configuration of the LSS slave

LSS can only be used if the LSS slave is in the status “stopped” or “pre-operational”.

Case 1: Individual LSS slave connected to the master

1. Transfer the LSS slave into the configuration mode:
   - Switch mode global (mode = 0x01) ➔ Tab. 2/2
2. Query node number:
   - Inquire node ID ➔ Tab. 2/25
3. Configure new node number:
   - Configure node ID ➔ Tab. 2/9

4. Configure new baud rate:
   - Configure bit timing parameters ➔ Tab. 2/11
5. Save the configuration:
   - Store configuration ➔ Tab. 2/14
6. Transfer the LSS slave into the normal mode:
   - Switch mode global (mode = 0x00) ➔ Tab. 2/2

Case 2:
Several LSS slaves connected to the master

1. Transfer the LSS slave into the configuration mode:
   - Selective mode change – vendor ID ➔ Tab. 2/4 (Festo = 0x1D)
   - Selective mode change – product code ➔ Tab. 2/5 (CPX-FB14 = 0xCD)
   - Selective mode change – revision number ➔ Tab. 2/6
   - Selective mode change – serial number ➔ Tab. 2/7
2. Query node number:
   - Inquire node ID ➔ Tab. 2/24
3. Configure new node number
   - Configure node ID ➔ Tab. 2/9
4. Configure new baud rate
   - Configure bit timing parameters ➔ Tab. 2/11
5. Save the configuration
   - Store configuration ➔ Tab. 2/14

6. Transfer the LSS slave into the normal mode
   - Switch mode global (mode = 0x00) ➔ Tab. 2/2

2.2.4 Addressing the CPX terminal

Before configuring, ascertain the exact number of available inputs/outputs. Dependent on what you have ordered, a CPX terminal comprises a different number of I/Os.

The I/Os will be assigned automatically within the CPX terminal (standard setting). The following applies to inputs and outputs:

– The address assignment of the inputs is independent of the outputs.

– The counting mode is independent of the position of the bus node. The bus node counts as a module with 0 or 8 inputs or 16 inputs and outputs, depending on the setting of DIL switch 5 (➔ section 1.2.2).

– Counting is from left to right, in ascending order without gaps.

➔

Note

– Observe that a CPX terminal provides status bits or an I/O diagnostic interface, dependent on the setting.

– The status bits must be treated like inputs and occupy 8 bits in the Transmit PDO 4 (standard setting).

– The 16 bits of the I/O diagnostic interface must be treated like inputs and outputs. They each occupy 16 bits in the Transmit and Receive PDO 4 (standard setting).

The following figure shows the standard distribution of I/Os on the PDOs in the remote I/O operating mode. If you use more than 8 I/O bytes, you must map these into the PDOs by “mapping”. In this case, the use of analogue channels will be limited. The same applies in the reverse case if more than 8 analogue channels are mapped into the PDOs by mapping.

Transmit PDO 1	I0...I7	I8...I15	I16...I23	I24...I31	I32...I39	I40...I47	I48...I55	I56...I63
Receive PDO 1	O0...O7	O8...O15	O16...O23	O24...O31	O32...O39	O40...O47	O48...O55	O56...O63

Transmit PDO 2	AI0	AI1	AI2	AI3
Receive PDO 2	AO0	AO1	AO2	AO3
Transmit PDO 3	AI4	AI5	AI6	AI7
Receive PDO 3	AO4	AO5	AO6	AO7
Transmit PDO 4	IW0 / diagnostics [1]	IW1	IW2	IW3
Receive PDO 4	OW0 / I/O diag. [2]	OW1	OW2	OW3

[1] Dependent on the configuration:
With status bits: I0 - I7, with I/O diagnostic interface: I0 ... I15
The input words of the technology modules shift correspondingly.

[2] Dependent on the configuration:
With activated I/O diagnostic interface: O0 ... O15 (➔ section 1.2.2)
The output words of the technology modules shift correspondingly.

Fig. 2/1: Overview of PDO 1 ... 4 and position of the status bits and I/O diagnostic interface

➔

Note

For the receive PDO 1 ... 4:

- The necessary telegram length depends on the CPX expansion and is 1 ... 8 byte.
- If the telegram received is shorter than the necessary telegram length, an error message will be output.
- If the telegram received is longer, the part corresponding to the necessary length will be processed.

Remote controller operating mode

In the remote controller operating mode (DIL switch 1) **only the PDOs 1** are assigned. They contain 64 logical I/Os for data exchange with the remote controller.

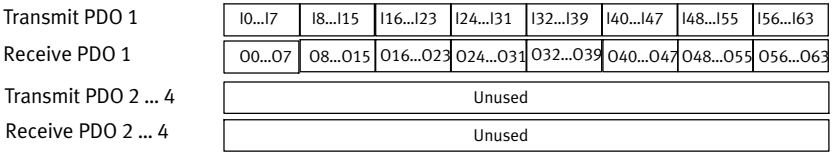


Fig. 2/2: 64 logical I/Os in the PDO 1 in the remote controller operating mode

2.2.5 Configuration examples

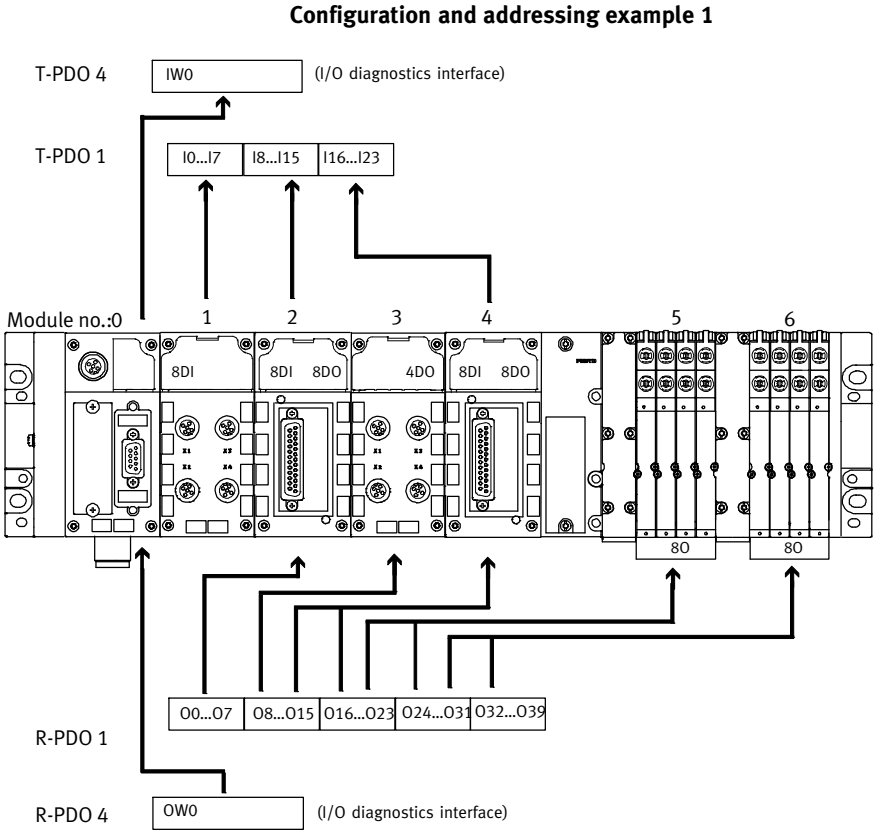


Fig. 2/3: Assignment of the PDOs on a CPX terminal with digital I/O modules, MPA pneumatics and activated I/O diagnostic interface
(standard assignment without mapping, configuration ➔ Tab. 2/35)

Module no.	Module	Input address	Output address
0	CANopen bus node CPX-FB14 With activated I/O diagnostic interface	T-PDO 4: IW0 Obj. 6100.1	R-PDO 4: OW0 Obj. 6300.1
1	Digital 8-off input module CPX-8DE	T-PDO 1: I0 ... I7 Obj. 6000.1	–
2	Digital multi I/O module CPX-8DE-8DA	T-PDO 1: I8 ... I15 Obj. 6000.2	R-PDO 1: O0 ... O7 Obj. 6200.1
3	Digital 4-off output module CPX-4DA	–	R-PDO 1: O8 ... O11 Obj. 6200.2
4	Digital multi I/O module CPX-8DE-8DA	T-PDO 1: I16 ... I23 Obj. 6000.3	R-PDO 1: O12 ... O19 Obj. 6200.2 Obj. 6200.3
–	MPA port pattern Passive module	–	–
5	MPA pneumatic module (8DO) MPA1S: VMPA1-FB-EMS-8 MPA pneumatic modules without separate power supply circuits	–	R-PDO 1: O20 ... O27 Obj. 6200.3 Obj. 6200.4
6	MPA pneumatic module (8DO) MPA1S: VMPA1-FB-EMS-8 MPA pneumatic modules without separate power supply circuits	–	R-PDO 1: O28 ... O35 Obj. 6200.4 Obj. 6200.5

Tab. 2/35: Configuration for example terminal 1 from Fig. 2/3

How you can prepare a changed configuration for this example with function assignment and virtual modules can be found in section 2.4.13.

Configuration and addressing example 2

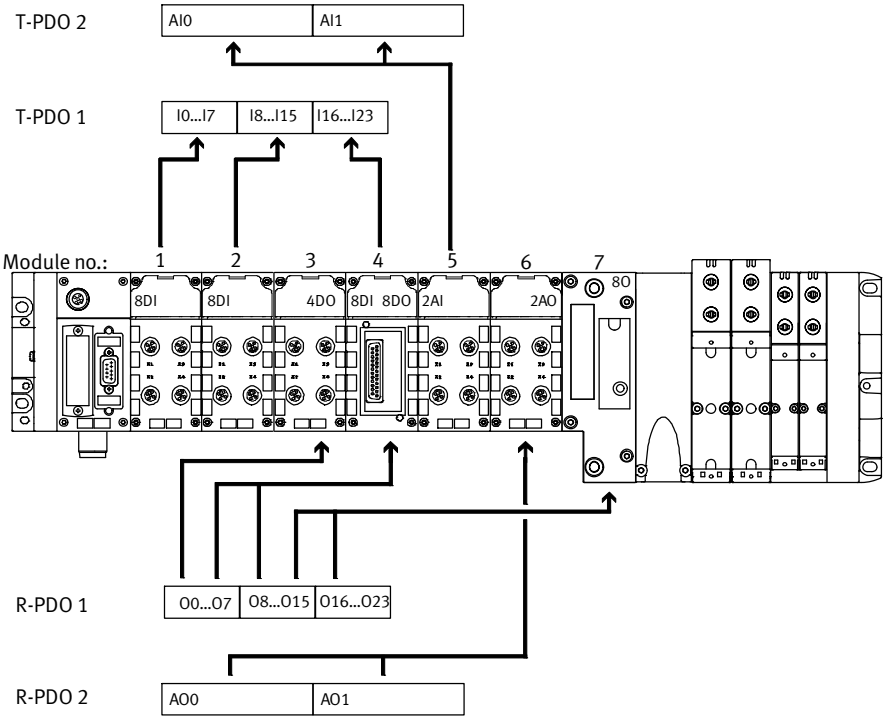


Fig. 2/4: Assignment of the PDOs on a CPX terminal with digital and analogue I/O modules, VTSA pneumatics (DIL switch setting 80) and not-activated diagnostic functions (standard assignment without mapping, configuration ➔ Tab. 2/36)

Module no.	Module	Input address	Output address
0	Bus nodes CPX-FB14 Without activation of diagnostic functions	–	–
1	Digital 8-off input module CPX-8DE	T-PDO 1: I0 ... I7 Obj. 6000.1	–
2	Digital 8-off input module CPX-8DE	T-PDO 1: I8 ... I15 Obj. 6000.2	–
3	Digital 4-off output module CPX-4DA	–	R-PDO 1: O0 ... O3 Obj. 6200.1
4	Digital multi I/O module CPX-8DE-8DA	T-PDO 1: I16 ... I23 Obj. 6000.3	R-PDO 1: O4 ... O11 Obj. 6200.1 Obj. 6200.2
5	Analogue 2-off input module CPX-2AE-U-I	T-PDO 2: AI0 ... AI1 Obj. 6401.1 Obj. 6401.2	–
6	Analogue 2-off output module CPX-2AA	–	R-PDO 2: AO0 ... AO1 Obj. 6411.1 Obj. 6411.2
7	VTSA pneumatic interface ISO plug-in (type 44) DIL switch in the interface set to 1 ... 8 solenoid coils (8DO)	–	R-PDO 1: O12 ... O19 Obj. 6200.2 Obj. 6200.3

Tab. 2/36: Configuration for example terminal 2 in Fig. 2/4

Configuration and addressing example 3

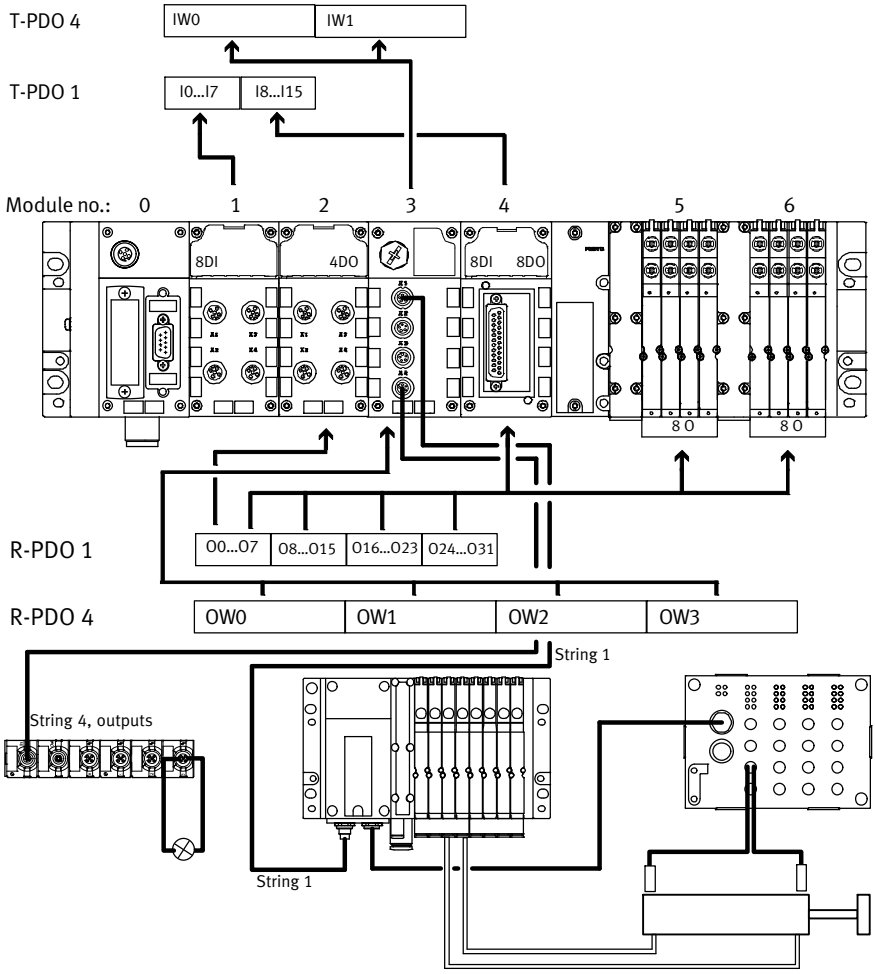


Fig. 2/5: Assignment of the PDOs on a CPX terminal with digital I/O modules, CPX-CP interface, MPA pneumatics and non-activated diagnostic functions (standard assignment without mapping, configuration ➔ Tab. 2/37)

Module no.	Module	Input address	Output address
0	Bus nodes CPX-FB14 Without activation of diagnostic functions	–	–
1	Digital 8-off input module CPX-8DE	T-PDO 1: I0 ... I7 Obj. 6000.1	–
2	Digital 4-off output module CPX-4DA	–	R-PDO 1: O0 ... O3 Obj. 6200.1
3	CPX-CP interface CPX-CP On string 1, 4 I bytes are assigned (32I) On string 1 ... 4, 16 O bytes are assigned (128O)	T-PDO 4: IW0 ... IW1 Obj. 6100.1 Obj. 6100.2	R-PDO 4: OW0 ... OW3 Obj. 6300.1 Obj. 6300.2 Obj. 6300.3 Obj. 6300.4 Manual mapping for OW4 ... OW7 [1)]
4	Digital multi I/O module CPX-8DE-8DA	T-PDO 1: I8 ... I15 Obj. 6000.2	R-PDO 1: O4 ... O11 Obj. 6200.1 Obj. 6200.2
–	MPA port pattern Passive module	–	–
5	MPA pneumatic module (8DO) MPA1S: VMPA1-FB-EMS-8 MPA pneumatic module	–	R-PDO 1: O12 ... O19 Obj. 6200.2 Obj. 6200.3
6	MPA pneumatic module (8DO) MPA1S: VMPA1-FB-EMS-8 MPA pneumatic module	–	R-PDO 1: O20 ... O27 Obj. 6200.3 Obj. 6200.4

[1)] **Manual mapping:** The CPX-CP interface occupies in the configuration 16 byte outputs (128O). Since the PDO 4 can only address the first 8 bytes (64O), manual mapping is required for configuration of this CPX terminal. As a result, the remaining output bytes can be made available over other PDOs. (OW4 ... OW7 are not depicted in Fig. 2/5).

Tab. 2/37: Configuration for example terminal 3 in Fig. 2/5

2.3 Overviews

2.3.1 Brief overview of the scope of functions

- Module states and boot-up as per Communication Profile CiA 301
- 1 Service Data Object for read and write access to the object directory: Send and Receive SDO
- 4 process data objects for access to digital and analogue inputs: Transmit PDO 1...4
- 4 process data objects for access to digital and analogue outputs: Receive-PDO 1 ... 4
- Emergency telegram for fault message to the master
- Node guarding and heart beat
- Default setting of all identifiers as per CiA 301 and the station number (predefined connection set)
- Variable mapping
- Function assignment and virtual modules
- Layer setting service (LSS)

2.3.2 Overview Object directory

Index (hex)	Objects	➔ Section
1000 ... 1200	Communication part of the object directories	2.4.1
1400 ... 1403	Communication parameters for Receive PDO 1...4	2.4.4
1800 ... 1803	Communication parameters for Transmit PDO 1...4	2.4.3
1600 ... 1603	Mapping parameters for Receive PDO 1 ... 4	2.4.4
1A00 ... 1A03	Mapping parameters for Transmit PDO 1...4	2.4.3
Manufacturer specific (2000 ... 5FFF):		
2000 ... 2110	System and module data	2.4.10
2200 ... 2210	System and module diagnostic data	
2300 ... 2310	Diagnostic memory data	
2400 ... 2421	System and module parameters	
4000 ... 4801	Function assignment module (virtual modules)	2.4.13
5000 ... 5FFF	Force tables	2.4.12
6000, 6100	Input array	2.4.3
6200, 6300	Output array	2.4.4
6206/6306	Fault mode array for the outputs	
6207/6307	Error state array for the outputs	
64xx	Analogue inputs and outputs	2.4.5

Tab. 2/38: Implemented objects of the CPX terminal

2.3.3 Behaviour of the CPX terminal when it is switched on

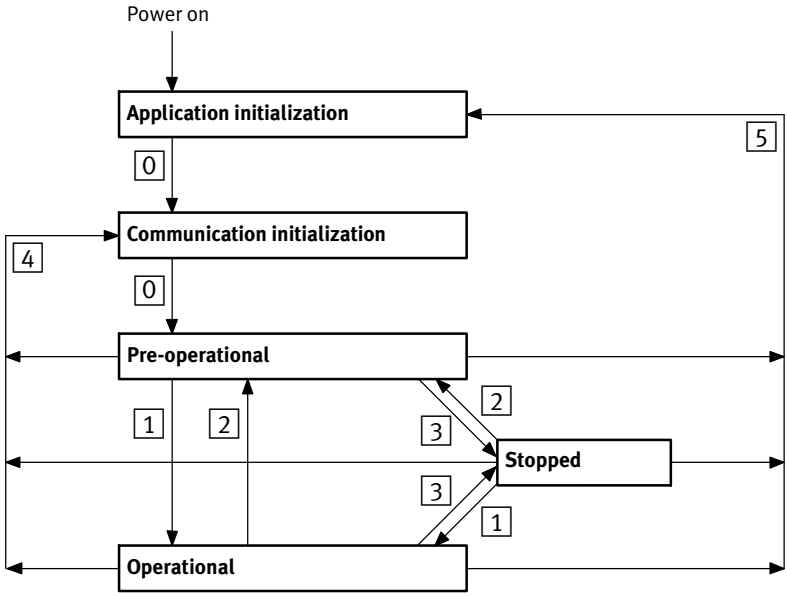


Fig. 2/6: Status transitions of the CPX terminal
(description ➔ Tab. 2/39 on the next page)

Description of the status transitions

Status transition	Designation	Command specifier (cs)	Function
0	–	–	Automatic boot-up after power on The saved parameters 2000 ... 5FFF are **only** loaded after power on is loaded [1]
1	Start_Remote_ Node_Indication	01_h	Starts the CPX terminal in operational mode: – SDO transmission valid – PDO transmission (outputs active) – Node guarding / heart beat valid (Node guard response: toggle + 05_h)
2	Enter_Pre_ Operation_State_ Indication	80_h	CPX terminal in pre-operational mode: – SDO transmission valid – PDO transmission **invalid** (outputs assume error status [2]) – Node guarding / heart beat valid (Node guard response: toggle + $7F_h$)
3	Stop_Node_ Indication	02_h	CPX terminal in stopped mode: – SDO transmission **invalid** – PDO transmission **invalid** (outputs assume error status [2]) – Node guarding / heart beat valid (Node guard response: toggle + 04_h)
4	Reset_ Communication_ Indication	82_h	Resetting the communication functions: – Outputs are reset – Communication parameters are reset (objects 1000 ... 1FFF)
5	Reset_Node_ Indication	81_h	Module reset including application: – Outputs are reset – Maskings of the outputs are reset to default – Communication parameters are reset (objects 1000 ... 1FFF) – Stored parameters (2000 ... 5FFF) are **not** reloaded.

[1] The objects 6000 ... are always loaded with the default settings after power-on
[2] Only after the transition from operational mode to stopped or pre-operational mode

Tab. 2/39: Status transitions

2.3.4 Default identifier distribution

The following table shows the identifier distribution:

Broadcast objects

Object name	Object designation	Range of values of the COB identifier on the CPX terminal
SYNC	–	080_h 128_d

Tab. 2/40: Broadcast objects

Peer-to-Peer objects

Object	Object designation	Range of values of the COB identifier
EMERGENCY	For procedures with high priority, e.g. undervoltage	081_h $0FF_h$ 129_d ... 255_d
Transmit PDO 1	PDO1 (tx)	181_h $1FF_h$ 385_d ... 511_d
Receive PDO 1	PDO1 (rx)	201_h $27F_h$ 513_d ... 639_d
Transmit PDO 2	PDO2 (tx)	281_h $2FF_h$ 641_d ... 767_d
Receive PDO 2	PDO2 (rx)	301_h $37F_h$ 769_d ... 895_d
Transmit PDO 3	PDO3 (tx)	381_h $3FF_h$ 897_d ... 1023_d
Receive PDO 3	PDO3 (rx)	401_h $47F_h$ 1025_d ... 1151_d
Transmit PDO 4	PDO4 (tx)	481_h $4FF_h$ 1153_d ... 1279_d
Receive PDO 4	PDO4 (rx)	501_h $57F_h$ 1281_d ... 1407_d
Transmit SDO	SDO1 (tx)	581_h $5FF_h$ 1409_d ... 1535_d
Receive SDO	SDO1 (rx)	601_h $67F_h$ 1537_d ... 1663_d
Node guarding / heart beat	Guarding	701_h $77F_h$ 1793_d ... 1919_d

Tab. 2/41: Peer-to-Peer objects of the CPX-FB14

2.4 Object directories

2.4.1 Communication profile

The following tables show the objects of the communication part (values and examples: module ID = 1).

In the following:
- U = unsigned
- ro = read only
- rw = read/write
- Map. = mapping possible
- Attr. = attribute

Note

For mapping, the rules in accordance with CiA 301 apply: Mapping entries are only possible if the number of parameters has previously been set to zero.
(Example: index 1O00, subindex 3 ... 8:
Set subindex 0 to “0”).

After entering the mapping values, set the number of parameters to the corresponding value again.

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
1000	0	Device type	U32	ro	–	00 0F 91 01	From software version V1.10: OF = maximum expansion of the CPX terminal
						00 0x 91 01	Prior to software version V1.10: 91 01 = device profile x = dependent on expansion of the CPX terminal: Bit 16: digital inputs Bit 17: digital outputs Bit 18: analogue inputs Bit 19: analogue outputs
						Example: 00 03 91 01	CPX terminal with digital inputs and outputs

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
1001	0	Error register	U8	ro	Yes	00	No error
						xx	Generic/manufacturer error (➔ section 3.5.1)
1002	0	Manufacturer status register	U32	ro	Yes	00 00 00 00	Module number and error number (➔ section 3.5.1)
1003	0	Pre-defined error field	U8	rw	–	00 ... 0A	Number of the current error (Write 00 deletes all errors) (➔ section 3.5.1)
	1	Standard error field	U32	ro		xx xx xx xx	Most recent error (n) – Byte 0 ... 1 = error code (➔ section 3.5.1) – Byte 2 = byte 0 of Index 1002 – Byte 3 = byte 1 of Index 1002
	2					xx xx xx xx	Error (n+1)
	3					xx xx xx xx	Error (n+2)
	...					...	...
	A_h					xx xx xx xx	Oldest error n+9
1005	0	COB-ID SYNC message	U32	rw	–	80	Default SYNC message COB-ID 80_h
1008	0	Manufacturer device name	Str.	ro	–	“FB14”	Node designation
1009	0	Manufacturer hardware version	Str.	ro	–	“0810” (example)	Current hardware status
100A	0	Manufacturer software version	Str.	ro	–	“V2.0” (example)	Current software version

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
100C	0	Guard time	U16	rw	–	00 00	Timeout monitoring [ms]
100D	0	Life time factor	U8	rw	–	00	Timeout monitoring (Guard time x life time factor = complete node guard time)
1014	0	COB-ID emergency object	U32	rw	–	80 + node ID	Default emergency object COB-ID 80_h + node ID
1015	0	Inhibit time emergency message	U16	rw	–	00 00	Transmit blocking time emergency message [100 µs]
1016	0	Consumer heart beat time	U8	ro	–	6	Number of entries
	1	C.-H. Time 1	U32	rw		00 00 00 00	Heart beat ID und heart beat time [ms]
	2	C.-H. Time 2				00 00 00 00	
	...	...				...	
	6	C.-H. Time 6				00 00 00 00	
1017	0	Producer heart beat time	U16	rw	–	00 00	Heart beat time [ms] COB-ID = node guard ID Status (pre-operational, operational, stopped)

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
1018	0	Identity object	U8	ro	–	4	Number of entries
	1	Vendor ID	U32			00 00 00 1D	Vendor ID (from CiA)
	2	Product code				00 00 00 CD	Product code
	3	Revision number				xx xx.xx xx	Version (like object 100A)
	4	Serial number				xx xx xx xx	Serial number (individual for each module)
1027	0	Module list	U8	ro	–	1 ...	Number of connected CPX modules
	1	Module 0	U16			➔ CPX system description	Module code module 0 [1)]
	2	Module 1					Module code module 1 [1)]
	3	Module 2					Module code module 2 [1)]
	...	...					...

[1)] Sequence as in CPX terminal from left to right.

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
1029	0	Error behaviour, number of error classes	U8	ro	–	3	Number of error classes
	1	Communication error		rw		00	With communication error (timeout/heart beat) 0 = Pre-operational 1 = No state change 2 = Stopped Error codes: 8130, 8140 From V1.10: 8100, 8130, 8140
	2	Output error				01	With short circuit/overload at output module 0 = Pre-operational 1 = No state change 2 = Stopped Error codes: 23xx, 33xx
	3	Input error				01	With short circuit/overload at input module or failure of sensor supply 0 = Pre-operational 1 = No state change 2 = Stopped Error codes: 21xx, 31xx
1200	0	Server SDO parameter	U8	ro	–	2	Number of entries
	1	COB_ID Client → Server (rx)	U32			600 + node ID	Default COB-ID + node ID
	2	COB_ID server → client (tx)				580 + node ID	Default COB-ID + node ID
U = unsigned ro = read only rw = read/write				Map. = Mapping possible Attr. = attribute			

Tab. 2/42: Objects of the communication part

2.4.2 Overview of the PDO structure

Default mapping	
PDO 1	Digital inputs/outputs (transmit/receive)
PDO 2	Analogue inputs/outputs channels 0 ... 3 (transmit/receive)
PDO 3	Analogue inputs/outputs channels 4 ... 7 (transmit/receive)
PDO 4	Technology modules, status bits, I/O diagnostic interface

Tab. 2/43: PDO structure

If required, the default PDO structure can be changed via SDO (➔ “PDO Communication Mapping Parameter” in the following sections, Index 1000_h ... $1A03_h$, 1600_h ... 1603_h)

2.4.3 Digital inputs (Transmit PDO 1)

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
181 ... 1FF	–	Transmit PDO 1	–	–	–	xx xx	Telegram length 1 ... 8 bytes Byte 0: I0 ... I7 Byte 1: I8 ... I15 ... Byte 7: I56 ... I63
1800	0	PDO communication parameter record	U8	ro	–	05	Number of entries
	1	PDO COB-ID	U32	rw		180 + node ID	Default COB-ID of the inputs
	2	Transmission type	U8			FF	Default: acyclic [1)]
	3	Inhibit time	U16			00 00	Transmit blocking time inputs [100 µs]
	4	–				–	Not used
	5	Event timer				00 00	Time-controlled transmission of the inputs [ms]

U = unsigned
ro = read only
rw = read/write

Map. = Mapping possible
Attr. = attribute

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
1A00	0	PDO communication mapping parameter	U8	rw	–	0 ... 8	Number of entries
	1		U32			60 00 01 08	Pointer at index I0 ... I7
	2					60 00 02 08	... Index I8 ... I15
	3					60 00 03 08	... Index I16 ... I23
	4					60 00 04 08	... Index I24 ... I31
	5					60 00 05 08	... Index I32 ... I39
	6					60 00 06 08	... Index I40 ... I47
	7					60 00 07 08	... Index I48 ... I55
	8					60 00 08 08	... Index I56 ... I63
6000	0	Read input 8-bit	U8	ro	–	0 ... 40	Number of 8-input groups
	1				Yes	xx	Status of inputs 0 ... 7
	2					xx	... Inputs 8 ... 15
	3					xx	... Inputs 16 ... 23
	4					xx	... Inputs 24 ... 31
	5					xx	... Inputs 32 ... 39
	6					xx	... Inputs 40 ... 47
	7					xx	... Inputs 48 ... 55
	8					xx	... Inputs 56 ... 63
	9					xx	... Inputs 64 ... 71
	A_h					xx	... Inputs 72 ... 79
	B_h					xx	... Inputs 80 ... 87
	C_h					xx	... Inputs 88 ... 95

U = unsigned
ro = read only
rw = read/write

Map. = Mapping possible
Attr. = attribute

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
6000	D_h	Read input 8-bit	U8	ro	Yes	xx	... Inputs 96 ... 103
	E_h					xx	... Inputs 104 ... 111
	F_h					xx	... Inputs 112 ... 119
	10_h					xx	... Inputs 120 ... 127
	...					...	...
	3D					xx	... Inputs 480 ... 487
	3E					xx	... Inputs 488 ... 495
	3F					xx	... Inputs 496 ... 503
	40_h					xx	... Inputs 504 ... 511

U = unsigned
ro = read only
rw = read/write

Map. = Mapping possible
Attr. = attribute

[1] During the transition from pre-operational to operational, the current SDO values will be “frozen” (e.g. analogue inputs). These values will be transmitted with each remote transmission request (RTR), independent of further settings (e.g. interrupt enable for analogue inputs).

Tab. 2/44: Digital inputs

2.4.4 Digital outputs (Receive PDO 1)

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
201 ... 27F	–	Receive PDO 1	–	–	–	xx xx xx xx	Telegram length 1 ... 8 bytes [1)] Byte 0: O0 ... O7 Byte 1: O8 ... O15 ... Byte 7: O56 ... O63
1400	0	PDO communication parameter record	U8	ro	–	02	Number of entries
	1	PDO COB-ID	U32	rw		200 + node ID	Default COB-ID of the outputs
	2	Transmission type	U8			FF	Default: acyclic
1600	0	PDO communication mapping parameter	U8	rw	–	0 ... 8	Number of entries
	1		U32			62 00 01 08	Pointer at index O0 ... O7
	2					62 00 02 08	... Index O8 ... O15
	3					62 00 03 08	... Index O16 ... O23
	4					62 00 04 08	... Index O24 ... O31
	5					62 00 05 08	... Index O32 ... O39
	6					62 00 06 08	... Index O40 ... O47
	7					62 00 07 08	... Index O48 ... O55
	8					62 00 08 08	... Index O56 ... O63

U = unsigned
ro = read only
rw = read/write

Map. = Mapping possible
Attr. = attribute

[1)] ➔ Note in section 2.2.4

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
6200	0	Write output 8 bit	U8	ro	–	0 ... 10	Number of 8-output groups
	1			rw	Yes	xx	Status of outputs 0 ... 7
	2					xx	... Outputs 8 ... 15
	3					xx	... Outputs 16 ... 23
	4					xx	... Outputs 24 ... 31
	5					xx	... Outputs 32 ... 39
	6					xx	... Outputs 40 ... 47
	7					xx	... Outputs 48 ... 55
	8					xx	... Outputs 56 ... 63
	9					xx	... Outputs 64 ... 71
	A_h					xx	... Outputs 72 ... 79
	B_h					xx	... Outputs 80 ... 87
	C_h					xx	... Outputs 88 ... 95
	D_h					xx	... Outputs 96 - 103
	E_h					xx	... Outputs 104 ... 111
	F_h					xx	... Outputs 112 ... 119
	10_h					xx	... Outputs 120 ... 127
	...					...	...
	3D					xx	... Outputs 480 ... 487
	3E					xx	... Outputs 488 ... 495
	3F					xx	... Outputs 496 ... 503
	40_h					xx	... Outputs 504 ... 511

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
6206	0	Fault mode output 8 bit	U8	ro	–	0 ... 40	Number of 8-output groups
	1			rw		FF	Fault mode outputs 0 - 7
	2					FF	... Outputs 8 ... 15
	3					FF	... Outputs 16 ... 23
	4					FF	... Outputs 24 ... 31
	5					FF	... Outputs 32 ... 39
	6					FF	... Outputs 40 ... 47
	7					FF	... Outputs 48 ... 55
	8					FF	... Outputs 56 ... 63
	9					FF	... Outputs 64 ... 71
	A_h					FF	... Outputs 72 ... 79
	B_h					FF	... Outputs 80 ... 87
	C_h					FF	... Outputs 88 ... 95
	D_h					FF	... Outputs 96 ... 103
	E_h					FF	... Outputs 104 ... 111
	F_h					FF	... Outputs 112 ... 119
	10_h					FF	... Outputs 120 ... 127
	...					...	...
	3D					FF	... Outputs 480 ... 487
	3E					FF	... Outputs 488 ... 495
	3F					FF	... Outputs 496 ... 503
	40					FF	... Outputs 504 ... 511

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
6207	0	Error state output 8-bit	U8	ro	–	0 ... 40	Number of 8-output groups
	1			rw		00	Error state outputs 0 ... 7
	2					00	... Outputs 8 ... 15
	3					00	... Outputs 16 ... 23
	4					00	... Outputs 24 ... 31
	5					00	... Outputs 32 ... 39
	6					00	... Outputs 40 ... 48
	7					00	... Outputs 48 ... 55
	8					00	... Outputs 56 ... 63
	9					00	... Outputs 64 ... 71
	A_h					00	... Outputs 72 ... 79
	B_h					00	... Outputs 80 ... 87
	C_h					00	... Outputs 88 ... 95
	D_h					00	... Outputs 96 ... 103
	E_h					00	... Outputs 104 ... 111
	...					...	...
	3D					00	... Outputs 480 ... 488
	3E					00	... Outputs 489 ... 495
	3F					00	... Outputs 496 ... 503
	40_h					00	... Outputs 504 ... 511

U = unsigned
ro = read only
rw = read/write

Map. = Mapping possible
Attr. = attribute

Tab. 2/45: Digital outputs

The statuses of the valves and outputs of the CPX valve terminal can be defined in case of error.

Note
With Index 6206 you can define the outputs which are to assume a defined status in the event of a fault.

With Index 6207 you can define the status which the fixed outputs are to assume in the event of a fault.

The settings do not become active until the CPX valve terminal is put into the operational mode.
After each switching on or after each reset (hardware initialization), the default values will automatically be accepted and any maskings will be overwritten.

The following applies:

Index (hex)	Definition
6206 Subindex 1 ... 10_h Bit 0 ... 7	0 = status of the output is retained
	1 = output assumes the status defined in Index 6207
6207 Subindex 1 ... 10_h Bit 0 ... 7	0 = output is reset
	1 = output is set

Tab. 2/46: Statuses of the valves and outputs in case of error

2.4.5 Analogue inputs channel 0 ... 3 (Transmit PDO 2)

CANopen represents the 16-bit analogue values with the following objects left justified in a 32-bit value:

– 6422, 6424, 6425, 6426, 6444, 5444, 5434

Values of an analogue input are loaded into the PDO only if the following requirements are fulfilled:

– Globale Interrupt Enable must be set to Enable (Index 6423).

– With the Interrupt Trigger (Index 6421), you can define how the analogue value in the following step is to be checked (minimum/maximum value, value modification, Index 6424, 6425, 6426).

The channel number of the interrupt-triggering analogue input is entered in Object 6422. The PDO is then transmitted according to the transmission code in Object 1801 (FF_h, FD_h, FC_h or 0 ... $F0_h$).

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
281 ... 2FF	–	Transmit PDO 2	–	–	–	xx	Telegram length 2, 4, 6 or 8 bytes Byte 0, 1: channel 0 (AI0) Byte 2, 3: channel 1 (AI1) Byte 4, 5: channel 3 (AI2) Byte 6, 7: channel 4 (AI3)
1801	0	PDO communication parameter record	U8	ro	–	05	Number of entries
	1	PDO COB-ID	U32	rw		280_h + node ID	Default COB-ID of the inputs
	2	Transmission type	U8			FF	Default: acyclic [1]
	3	Inhibit time	U16			01 4F (= 50 ms)	Transmit blocking time inputs [100 µs]
	4	–				–	Not used
	5	Event timer				00 00	Time-controlled transmission of the inputs [ms]

U = unsigned
ro = read only
rw = read/write

Map. = Mapping possible
Attr. = attribute

[1] ➔ Note on page 2-49

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
1A01	0	PDO communication mapping parameter	U8	rw	–	0 ... 8	Number of entries
	1		U32			64 01 01 10	Pointer at index AI0
	2					64 01 02 10	... Index AI1
	3					64 01 03 10	... Index AI2
	4					64 01 04 10	... Index AI3
	5					00 00 00 00	... on mapping object 5
	6					00 00 00 00	... on mapping object 6
	7					00 00 00 00	... on mapping object 7
	8					00 00 00 00	... on mapping object 8
6401	0	Read analogue input	U8	ro	–	0 ... 10	Number of analogue channels
	1		I16		Yes	xx	AI0
	2					xx	AI1
	3					xx	AI2
	4					xx	AI3
6423	0	Analogue input global interrupt enable	B	rw	–	00	Global interrupt enable 0 = disable 1 = enable
6422	0	Analogue input number of interrupt source banks	U8	ro	–	1	Number of interrupt source banks
	1	Interrupt source bank 1	U32		–	00	Interrupt source bank 1 [1)] (channel 0 ... 15)

[1)] Reset automatically after read access

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
6421	0	Analogue input interrupt trigger selection	U8	ro	–	0 ... 10	Number of analogue inputs
	1	Analogue input		rw		00	AI0 Bit 0: Upper limit value exceeded [1] Bit 1: Lower limit value exceeded [2] Bit 2: Modification greater than Delta [3] Bit 3 ... 7: reserved
	2					00	AI1
	3					00	AI2
	4					00	AI3
6424	0	Analogue input interrupt upper limit integer	U8	ro	–	0 ... 10	Number of analogue inputs
	1	Analogue input	I32	rw		00	Maximum value AI0 [1]
	2					00	Maximum value AI1 [1]
	3					00	Maximum value AI2 [1]
	4					00	Maximum value AI3 [1]

[1] Bit 0: “Upper limit exceeded” (as per CiA 401)
[2] Bit 1: “Input below lower limit” (as per CiA 401)
[3] Bit 2: “Input changed by more than delta” (as per CiA 401)

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
6425	0	Analogue input interrupt upper limit integer	U8	ro	–	0 ... 10	Number of analogue inputs
	1	Analogue input	I32	rw		00	Minimum value AI0 [2]
	2					00	Minimum value AI1 [2]
	3					00	Minimum value AI2 [2]
	4					00	Minimum value AI3 [2]
6426	0	Analogue input interrupt delta unsigned	U8	ro	–	0 ... 10	Number of analogue inputs
	1	Analogue input	U32	rw		00	Minimum value modification AI0 [3]
	2					00	Minimum value modification AI1 [3]
	3					00	Minimum value modification AI2 [3]
	4					00	Minimum value modification AI3 [3]

[2] Bit 1: "Input below lower limit" (as per CiA 401)
[3] Bit 2: "Input changed by more than delta" (as per CiA 401)

Tab. 2/47: Analogue inputs channel 0 ... 3

2.4.6 Analogue outputs channel 0 ... 3 (Receive PDO 2)

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
301 ... 37F	–	Receive PDO 2	–	–	–	xx	Telegram length 2, 4, 6 or 8 bytes Byte 0, 1: channel 0 (AO0) Byte 2, 3: channel 1 (AO1) Byte 4, 5: channel 2 (AO2) Byte 6, 7: channel 3 (AO3)
1401	0	PDO communication parameter record	U8	ro	–	02	Number of entries
	1	PDO COB-ID	U32	rw		300 + node ID	Default COB-ID of the inputs
	2	Transmission type	U8			FF	Default: acyclic
1601	0	PDO communication mapping parameter	U8	rw	–	0 ... 8	Number of entries
	1		U32			64 11 01 10	Pointer at index AO0
	2					64 11 02 10	... Index AO1
	3					64 11 03 10	... Index AO2
	4					64 11 04 10	... Index AO3
	5					00 00 00 00	... on mapping object 5
	6					00 00 00 00	... on mapping object 6
	7					00 00 00 00	... on mapping object 7
	8					00 00 00 00	... on mapping object 8

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
6411	0	Write analogue output 16 bit	U8	ro	Yes	0 ... 10	Number of analogue channels
	1		I16	rw		xx xx	AO0
	2					xx xx	AO1
	3					xx xx	AO2
	4					xx xx	AO3
6443	0	Analogue output fault mode	U8	ro	–	0 ... 10	Number of analogue channels
	1			rw		1	Default mode AO0
	2					1	Default mode AO1
	3					1	Default mode AO2
	4					1	Default mode AO3
6444	0	Analogue output error integer 32 bit	U8	ro	–	0 ... 10	Number of analogue channels
	1		I32	rw		1	Error value AO0
	2					2	Error value AO1
	3					3	Error value AO2
	4					4	Error value AO3

U = unsigned
ro = read only
rw = read/write

Map. = Mapping possible
Attr. = attribute

Tab. 2/48: Analogue outputs channel 0 ... 3

2.4.7 Analogue inputs channel 4 ... 15 (Transmit PDO 3)

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
381 ... 3FF	–	Transmit PDO 3	–	–	–	xx	Telegram length 2, 4, 6 or 8 bytes Byte 0, 1: channel 4 (AI4) Byte 2, 3: channel 5 (AI5) Byte 4, 5: channel 6 (AI6) Byte 6, 7: channel 7 (AI7)
1802	0	PDO communication parameter record	U8	ro	–	05	Number of entries
	1	PDO COB-ID	U32	rw		380 + node ID	Default COB-ID of the inputs
	2	Transmission type	U8			FF	Default: acyclic [1)]
	3	Inhibit time	U16			01 F4 (= 50 ms)	Transmit blocking time inputs [100 µs]
	4	–				–	Not used
	5	Event timer				00 00	Time-controlled transmission of the inputs [ms]

U = unsigned
ro = read only
rw = read/write

Map. = Mapping possible
Attr. = attribute

1) ➔ Note on page 2-49

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
1A02	0	PDO communication mapping parameter	U8	rw	–	0 ... 8	Number of entries
	1		U32			64 01 05 10	Pointer at index AI4
	2					64 01 06 10	... Index AI5
	3					64 01 07 10	... Index AI6
	4					64 01 08 10	... Index AI7
	5					00 00 00 00	... on mapping object 5
	6					00 00 00 00	... on mapping object 6
	7					00 00 00 00	... on mapping object 7
	8					00 00 00 00	Pointer on mapping object 8
6401	0	Read analogue input	U8	ro	–	0 ... 10	Number of analogue channels
	5		I16		Yes	xx xx	AI4
	6					xx xx	AI5
	...					...	...
	10_h					xx xx	AI15
6422	0	Analogue input number of interrupt source banks	U8	ro	–	1	Number of interrupt source banks (➔ PDO 2)
	1	Interrupt source bank 1	U32	ro	–	00	Interrupt source bank 1 [1] (channel 1 ... 16)

[1] Reset automatically after read access

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
6421	0	Analogue input interrupt trigger selection number of analogue input	U8	ro	–	0 ... 10	Number of analogue inputs
	5	Analogue input		rw		00	AI4
	6					00	AI5
	...					...	...
	10_h					00	AI15
6424	0	Analogue input interrupt upper limit integer	U8	ro	–	0 ... 10	Number of analogue inputs
	5	Analogue input	I32	rw		00	Maximum value AI4
	6					00	Maximum value AI5
	...					...	...
	10_h					00	Maximum value AI15
6425	0	Analogue input interrupt upper limit integer	U8	ro	–	0 ... 10	Number of analogue inputs
	5	Analogue input	I32	rw		00	Minimum value AI4
	6					00	Minimum value AI5
	...					...	...
	10_h					00	Minimum value AI15

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
6426	0	Analogue input interrupt delta unsigned	U8	ro	–	0 ... 10	Number of analogue inputs
	5	Analogue input	U32	rw		00	Minimum value change AI4
	6					00	Minimum value change AI5
	...					00	...
	10_h					00	Minimum value change AI15

Tab. 2/49: Analogue inputs channel 4 ... 15 (Transmit PDO 3)

2.4.8 Analogue outputs channel 4 ... 15 (Receive PDO 3)

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
401 ... 47F	–	Receive PDO 3	–	–	–	xx	Telegram length 2, 4, 6 or 8 bytes Byte 0, 1: channel 5 (AO4) Byte 2, 3: channel 6 (AO5) Byte 4, 5: channel 7 (AO6) Byte 6, 7: channel 8 (AO7)
1402	0	PDO communication parameter record	U8	ro	–	02	Number of entries
	1	PDO COB-ID	U32	rw		400 + node ID	Default COB-ID of the inputs
	2	Transmission type	U8			FF	Default: acyclic

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
1602	0	PDO communication mapping parameter	U8	rw	–	0 ... 8	Number of entries
	1		U32			64 11 05 10	Pointer on index AO4
	2					64 11 06 10	... Index AO5
	3					64 11 07 10	... Index AO6
	4					64 11 08 10	... Index AO7
	5					00 00 00 00	... on mapping object 5
	6					00 00 00 00	... on mapping object 6
	7					00 00 00 00	... on mapping object 7
	8					00 00 00 00	... on mapping object 8
6411	0	Write analogue output 16 bit	U8	ro	–	0 ... 10	Number of analogue channels
	5		I16	rw	Yes	xx	AO4
	6					xx	AO5
	...					...	...
	10_h					xx	AO15
6443	0	Analogue output fault mode	U8	ro	–	0 ... 10	Number of analogue channels
	5			rw		1	Default mode AO4
	6					1	Default mode AO5
	...					...	...
	10_h					1	Default mode AO15

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
6444	0	Analogue output error integer 32 bit	U8	ro	–	0 ... 10	Number of analogue channels
	5		I32	rw		00 00 00 00	Error value AO4
	6					00 00 00 00	Error value AO5
	...					...	...
	10_h					00 00 00 00	Error value AO15

Tab. 2/50: Analogue outputs channel 4 ... 15 (Receive PDO 3)

2.4.9 Technology modules, status bits, I/O diagnostic interface (PDO 4)

Note
In order to use the status bits or the I/O diagnostic interface, they must be activated via the DIL switches on the bus node (➔ section 1.2.2).

Further information on the status bits and on the I/O diagnostic interface can be found in section 3.3 and 3.4.

Transmit PDO 4

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
481 ... 4FF	–	Transmit PDO 4	–	–	–	xx	Telegram length 2, 4, 6 or 8 bytes Byte 0, 1: status bits or I/O diagnostics interface (dependent on configuration) Byte 2, 3: reserved Byte 4, 5: reserved Byte 6, 7: reserved
1803	0	PDO communication parameter record	U8	ro	–	05	Number of entries
	1	PDO COB-ID	U32	rw		480 + node ID	Default COB-ID of the inputs
	2	Transmission type	U8			FF	Default: acyclic [1)]
	3	Inhibit time	U16			00 00	Transmit blocking time inputs [100 µs]
	4	–				–	Not used
	5	Event timer				00 00	Time-controlled transmission of the inputs [ms]

1) ➔ Note on page 2-49

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
1A03	0	PDO communication mapping parameter	U8	rw	–	0 ... 8	Number of entries
	1		U32			61 00 01 10	Pointer on IW0
	2					61 00 02 10	... on IW1
	3					61 00 03 10	... on IW2
	4					61 00 04 10	... on IW3
	5					00 00 00 00	... on mapping object 5
	6					00 00 00 00	... on mapping object 6
	7					00 00 00 00	... on mapping object 7
	8					00 00 00 00	... on mapping object 8
6100	0	Read input 16-bit	U8	ro	Yes	0 ... 20	Number of IW groups
	1		U16			xx	IW0, depending on configuration [1]: – Status bits or – I/O diagnostic interface – 1st Input word technology module
	2					xx	IW1: depending on configuration: 1st or 2nd input word technology module [1]
	3					xx	IW2 technology module
	...					...	...
	20_h					xx	IW31 technology module
[1] Depending on diagnostic setting							

Tab. 2/51: Transmit PDO 4

Receive PDO 4

A description of the functioning of the I/O diagnostic interface can be found in the Diagnostics chapter of the CPX system description.

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
501 ... 57F	–	Receive PDO 4	–	–	–	xx	Telegram length 1...8 bytes Byte 0, 1: I/O diagnostics interface (if configured) Byte 2, 3: reserved Byte 4, 5: reserved Byte 6, 7: reserved
1403	0	PDO communication parameter record	U8	ro	–	02	Number of entries
	1	PDO COB-ID	U32	rw		500 + node ID	Default COB-ID of the inputs
	2	Transmission type	U8			FF	Default: acyclic
1603	0	PDO communication mapping parameter	U8	rw	–	0 ... 8	Number of entries
	1		U32			63 00 01 10	Pointer on OW0
	2					63 00 02 10	... on OW1
	3					63 00 03 10	... on OW2
	4					63 00 04 10	... on OW3
	5					00 00 00 00	... on mapping object 5
	6					00 00 00 00	... on mapping object 6
	7					00 00 00 00	... on mapping object 7
	8					00 00 00 00	... on mapping object 8

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
6300	0	Write output 16 bit	U8	ro	–	0 ... 8	Number of 16-output groups
	1		U16	rw	Yes	xx	If configured: – I/O diagnostic interface
	2 ... 8					–	Reserved
6300	0	Write output 16 bit	U8	rw	Yes	0 ... 20	Number of OW groups
	1		U16			xx	OW0 technology module
	2					xx	OW1 technology module
	3					xx	OW2 technology module
	...					...	...
	20_h					xx	OW31 technology module
6306	0	Fault mode output 16 bit	U8	ro	–	0 ... 20	Number of OW groups
	1		U16	rw		FF FF	Fault mode OW0
	2					FF FF	... OW1
	3					FF FF	... OW2
	...					...	...
	20					FF FF	... OW31
6307	0	Error state output 16-bit	U8	ro	–	0 ... 20	Number of OW groups
	1		U16	rw		00 00	Fault mode OW0
	2					00 00	... OW1
	3					00 00	... OW2
	...					...	...
	20					00 00	... OW31

Tab. 2/52: Receive PDO 4

Note
With Index 6306 you can define the outputs which are to assume a defined status in the event of a fault.

With Index 6307 you can define the status which the fixed outputs are to assume in the event of a fault.

The settings do not become active until the CPX valve terminal is put into the operational mode.
After each switching on or after each reset (hardware initialization), the default values will automatically be accepted and any maskings will be overwritten.

2.4.10 Manufacturer specific profile

Additional information can be found in the following tables and in the CPX system description (P.BE-CPX-SYS-...).

Index (hex)	Designation	Map.	Explanation
2000	System data (global system configuration)	–	Operating mode, details ➔ Tab. 2/54
2010	Module data	–	Details ➔ Tab. 2/55
2200	System diagnostics data	Yes	Details ➔ Tab. 2/56
2210	Module diagnostics data	–	Details ➔ Tab. 2/57

Tab. 2/53: Overview of the indices of the manufacturer specific profile area

System data							
Index (hex)	**Sub-index**	**Designation**	**Type**	**Attr.**	**Values (hex)**	**Explanation**	**Function no.**
2000	0	System data	U8	ro	3	Number of parameters	–
	1	Operating mode 1			xx	CPX operating mode Bit 0 ... 3: CPX operating mode Bit 4: CPX expansion Bit 5: handheld unit Bit 6: force mode Bit 7: system start	0000
	2	Fail safe			xx	➔ Index 6206, 6207, 6306, 6307	0001
	3	Monitoring the CPX terminal			xx	Monitoring the CPX terminal: Bit 0 ... 3: short circuit/ overload/undervoltage Bit 4 ... 7: reserved	0002

Tab. 2/54: System data

Module data

Index (hex)	Sub-index	Designation	Type	Attr.	Values (hex)	Explanation	Function no.
2010	0	Module data	U8	ro	1 ...	Number of entries	16 + xx [1]
	1	Module 0	U16		xx xx	Module type [1] (module code + revision code)	
	2	Module 1			xx xx	Module type [1] (module code + revision code)	
	3	Module 2			xx xx	Module type [1] (module code + revision code)	
	...	...			...	...	
2110	0	–	U8	ro	1 ...	Number of entries	784 + xx [1]
	1	Module serial number module 0	U32		xx xx xx xx	Module serial number [1]	
	2	Module serial number module 1	U32		xx xx xx xx		
	...	...			...	...	

[1] All details: ➔ Appendix of the CPX system description

Tab. 2/55: Module data

System diagnostics data							
Index (hex)	**Sub-index**	**Designation**	**Type**	**Attr.**	**Values (hex)**	**Explanation**	**Function no.**
2200	0		U8	ro	8	Number of entries	–
	1	Status byte			0 ... FF	Status bits	1936
	2	Module number			0, 40, ...	Number of the module with diagnostic message (bit 0...5) Diagnostics completed (bit 6)	1937
	3	Error number			0 ... FF	Error number	1938
	4 ... 8	Reserved			–	Reserved	1939 ... 1943

Tab. 2/56: System diagnostic data (PDO mapping is possible)

Module diagnostics data							
Index (hex)	**Sub-index**	**Designation**	**Type**	**Attr.**	**Values (hex)**	**Explanation**	**Function no.**
2210	0	Module diagnostics	U8	ro	1 ...	Number of entries	–
	1	Diagnostics module 0	U32	ro	00 ... FF 00 ... FF 00 00	I/O channel/channel number Error number Reserved Reserved	2008 + xx [1]
	2	Diagnostics module 1			00 ... FF 00 ... FF 00 00	I/O channel/channel number Error number Reserved Reserved	
	...	...			...	...	
[1] All details: ➔ Appendix of the CPX system description							

Tab. 2/57: Module diagnostics data

Diagnostic memory parameters and data

Index (hex)	Sub-index	Designation	Type	Attr.	Values (hex)	Explanation	Function no.
2300	0	Status/ mode diagnostic memory	U8	ro	8	Number of entries	–
	1			rw	xx	Diagnostic memory mode	3480
	2			–	–	–	–
	3			rw	00	Number of entries in the diagnostic memory (Writing “0” will delete all entries)	3482
	4			ro	00	Current status / overflow	3483
	5			rw	00	Trigger conditions (run/stop filter 2, error end filter, error number filter, module/channel filter)	3484
	6				00	Module number (MN)	3485
	7				00	Channel number (CN)	3486
	8				00	Error number (EN)	3487
2310	0	Diagnostic memory	U8	ro	0 ... 28	Number of entries	–
	1	1st entry (latest error)	Oct. string		00 ... FF 00 ... 17 00 ... 3B 00 ... 3B 00 ... 63 (+ 80) 00 ... FF 00 ... 2F 00 ... FF 00 ... FF 00 ... FF	Number of days Number of hours Number of minutes Number of seconds Number of 10 ms (and designation for 1st. message after power on) Module code Module position Channel number Error number Following channels	3488, ...
	2	2nd entry					
	3	3rd entry					
	...	...					
	28_h	40th entry (oldest saved error)					

Tab. 2/58: Diagnostic memory data

System parameters

Index (hex)	Sub-index	Designation	Type	Attr.	Values (hex)	Explanation	Function no.
2400	0	System parameters	U8	ro	8	Number of entries	–
	1	Parameter byte 0		rw	0 ... FF	Reserved	4400
	2	Parameter byte 1			0 ... FF	Monitoring (active/inactive)	4401
	3	Parameter byte 2			0 ... FF	Bit 0, 1: not used [1)] Bit 2, 3: force mode Bit 4, 5: not used Bit 6, 7: system start [2)]	4402
	4 ... 8	Reserved			–	Reserved	–

1) **Note:** The bus node supports only the mode “Faultmode benutzen” or “Assume fault mode” (➔ Festo Maintenance Tool).
The error characteristics of the individual outputs are parameterised through the objects 6206 and 6207. Outputs whose error characteristics have not been parameterised are reset in case of error.
Outputs whose error characteristics have not been parameterised are reset in case of error.
(Information on parameterisation of the outputs’ error characteristics ➔ Tab. 2/46)

2) At system start with saved parameterisation, only the objects 2000 ... 5FFF are loaded. The objects 6000 ... are always loaded with the default settings after power-on.

Tab. 2/59: System parameters

Detailed information on parameters and data can be found in the CPX system description.

Module parameters

Index (hex)	Sub-index	Designation	Type	Attr.	Values (hex)	Explanation	Function no.
2410	0	Module Parameter	U8	ro	40	Number of entries	–
	1	Parameter 0 Module 0		rw	0 ... FF	– Monitoring the CPX module – Behaviour after short circuit/overload – Input debounce time – Signal extension time – Data format of analogue values	4828, ...
	2	Parameter 1 Module 0			0 ... FF		
	...	...			...		
	40_h	Parameter 63 Module 0			0 ... FF		
2411	0	Module Parameter	U8	ro	40_h	Number of entries	–
	1	Parameter 0 Module 1		rw	0 ... FF	– Monitoring the CPX module – Behaviour after short circuit/overload – Input debounce time – Signal extension time – Data format of analogue values	xx [1]
	...	...			...		
	40_h	Parameter 63 Module 1			0 ... FF		
2412, ...	0 ... 40_h	Parameters 0 ... 63 Module 2 ...	U8	...	...	➔ CPX system description appendix B	xx [1]

[1] Module-dependent, ➔ CPX system description

Tab. 2/60: Module parameters

2.4.11 Overview of mappingobjects

The following table shows the objects for which mapping is possible:

Index (hex)	Sub-index	Designation	Type	Attr.	Values (hex)	Explanation
1001	0	Error register	U8	ro	00	Number of errors
1002	0	Manufacturer status register	U32	ro	00 00 00 00	Module number and error number
2200	1	System diagnostics data	U8	ro	xx	Status bits
	2					Number of the module with diagnostic message
	3					Error number
6000	1	Read input 1 ... 8	U8	ro	xx	Status of the inputs (digital or status bits) I0 ... I7
	...	...				...
	10_h	Read input 121 ... 128				I120 ... I127
6100	1	Read input 16-bit	U16	ro	xx	Status of the inputs (technology modules or I/O diagnostics interface) IW0
	...					...
	20_h					IW31

Index (hex)	Sub-index	Designation	Type	Attr.	Values (hex)	Explanation
6200	1	Write output 1 ... 8	U8	rw	xx	Status of the outputs (digital or valves) O0 ... O7
	...	...				...
	10_h	Write output 121 ... 128				O120 ... O127
6300	1	Write output 16bit	U16	rw	xx	Status of the outputs (technology modules) OW0
	...					...
	20_h					OW31
6401	1	Read analogue input 1	I16	ro	xx	Analogue input channels Default mapping AI0
	...	...				...
	10_h	Read analogue input 16				AI15
6411	1	Write analogue output 1	I16	rw	xx	Analogue output channels AO0
	...	...				...
	10_h	Write analogue output 16				AO15

Tab. 2/61: Overview of mapping objects

2.4.12 Forcing

The Force function enables the manipulation of signal statuses disconnected from actual operating statuses and is used mainly during the commissioning phase. Further information can be found in the appendix of the CPX system description (P.BE-CPX-SYS-...).

CANopen represents 16-bit analogue values left-justified in a 32-bit value.

Force table inputs

Index (hex)	Sub-index	Designation	Type	Attr.	Values (hex)	Explanation	Function no.
5000	0	Force enable	U8	ro	0	Bit 0: enable force [1] (Corresponds to index 2400,3 bit 2, 3)	–
5006	0	Force mode 8-bit digital inputs	U8	ro	0 ... 10	Number of entries	–
	1			rw	0	Force mode I0 ... I7	
	2				0	Force mode I8 ... I15	
	...				...	...	
	10_h				0	Force mode I120 ... I127	
5007	0	Force mode 8-bit digital inputs	U8	ro	0 ... 10	Number of entries	–
	1			rw	0	Force value I0 ... I7	
	2				0	Force value I8 ... I15	
	...				...	...	
	10_h				0	Force value I120 ... I127	

Index (hex)	Sub-index	Designation	Type	Attr.	Values (hex)	Explanation	Function no.
5106	0	Force mode 16-bit digital inputs	U8	ro	0 ... 20	Number of entries	–
	1		U16	rw	0	Force mode IW0	
	2				0	Force mode IW1	
	...				...	...	
	20_h				0	Force mode IW31	
5107	0	Force value 16-bit digital inputs	U8	ro	0 ... 20	Number of entries	–
	1		U16	rw	0	Force value IW0	
	2				0	Force value IW1	
	...				...	...	
	20_h				0	Force value IW31	
5433	0	Force mode analogue inputs	U8	ro	0 ... 10	Number of entries	–
	1			rw	0	Force mode channel 0 [1] (AI0)	
	2				0	Force mode channel 1 (AI1)	
	...				...	...	
	10_h				0	Force mode channel 15 (AI15)	
5434	0	Force value analogue inputs	U8	ro	0 ... 10	Number of entries	–
	1		I32	rw	0	Force value channel 0 (AI0)	
	2				0	Force value channel 1 (AI1)	
	...				...	...	
	10_h				0	Force value channel 15 (AI15)	

[1] Values: 0 = disable
1 = enable

Force table outputs

Index (hex)	Sub-index	Designation	Type	Attr.	Values (hex)	Explanation	Function no.
5206	0	Force mode 8-bit digital outputs	U8	ro	0 ... 10	Number of entries	–
	1			rw	0	Force mode O0 ... O7	
	2				0	Force mode O8 ... O15	
	...				...	...	
	10_h				0	Force mode O120 ... O127	
5207	0	Force value 8-bit digital outputs	U8	ro	0 ... 10	Number of entries	–
	1			rw	0	Force value O0 ... O7	
	2				0	Force value O8 ... O15	
	...				...	...	
	10_h				0	Force value O120 ... O127	
5306	0	Force mode 16-bit digital outputs	U8	ro	0 ... 20	Number of entries	–
	1		U16	rw	0	Force mode OW0	
	2				0	Force mode OW1	
	...				...	...	
	20_h				0	Force mode OW31	
5307	0	Force value 16-bit digital outputs	U8	ro	0 ... 20	Number of entries	–
	1		U16	rw	0	Force value OW0	
	2				0	Force value OW1	
	...				...	...	
	20_h				0	Force value OW31	

Index (hex)	Sub-index	Designation	Type	Attr.	Values (hex)	Explanation	Function no.
5443	0	Force mode analogue outputs	U8	ro	0 ... 10	Number of entries	–
	1			rw	0	Force mode channel 0 [1] (AO0)	
	2				0	Force mode channel 1 (AO1)	
	...				...	...	
	10_h				0	Force mode channel 15 (AO15)	
5444	0	Force value analogue outputs	U8	ro	0 ... 10	Number of entries	–
	1		I32	rw	0	Force value channel 0 [1] (AO0)	
	2				0	Force mode channel 1 (AO1)	
	...				...	...	
	10_h				0	Force mode channel 15 (AO15)	

[1] Values: 0 = disable
1 = enable

Tab. 2/62: Overview of mapping objects

2.4.13 Function assignment and virtual modules

Function assignment lets you operate various expanded CPX terminals with only one PLC software program. You can, for example, configure a maximum expansion of a CPX terminal in your system and, for the other terminals, suppress the modules that are not physically present. Object 4800 is used for this purpose: With it, you can define modules as “virtual” or physically present and so show or suppress them. There are no address shifts through the use of virtual modules.

An additional application possibility of the function assignment is to configure the CPX terminal with extensions for another function of the CPX terminal and only show these virtual modules later with the object 4800.

In addition, you can use the object 4801, to check the nominal configuration of the CPX terminal.

This function is available only for digital I/O modules. The following objects can only be written if the following conditions are met:

– The CPX-FB14 is in pre-operational mode.

– No error is generated from the object 4800,0.

– Object 4000 = 0.

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
4000	–	Function assignment mask enable	Bool	rw	–	0	Function assignment and virtual modules deactivated
						1	Function assignment and virtual modules activated
4001	0	Function assignment mask inputs	U8	rw	–	0 ... 10	Number of entries
	1 ... 10_h					xx	0 = enter virtual bits in object 6000 (input array) 1 = enter physically present bits in object 6000 (input array) (default setting)
4200	0	Function assignment mask outputs	U8	rw	–	0 ... 10	Number of entries
	1 ... 10_h					xx	0 = enter virtual bits in object 6200 (output array) 1 = enter physically present bits in object 6200 (output array) (default setting)
4800	0	Set module config function assignment	U8	rw	–	0 ... 30h	Number of the configuration entries used
	1 ... 48		U32			With these entries, a possible system structure including virtual modules is defined. – Byte 0: number of output bits (digital modules) or number of output bytes (analogue modules) – Byte 1: like byte 0 but for the inputs – Byte 2: CPX module code specification (with 0 = no module code specification) – Byte 3: bit 7: 0 = physically present module, 1 = virtual module Bit 6 ... 2: reserved Bit 1 ... 0: module type: 00 = digital, 01 = analogue, 10 = technology module	

Index (hex)	Sub-index	Designation	Type	Attr.	Map.	Values (hex)	Explanation
4801		Check module function assignment				0	Set module config not used
						01 00 00 00	Target/actual comparison successful
						80 ff oo mm	ff : Error cause (see below) oo: Subindex of the object 4800 in which the error occurred mm: Module number in which the error occurred
Significance of ff (error cause in object 4801): 01 = Number of inputs of the module different 02 = Number of outputs of the module different 04 = Incorrect module code 08 = Module not permitted as virtual (e.g. analogue module) 10 = Sum of the inputs exceeded (› 128 bit) 20 = Sum of the outputs exceeded (› 128 bit) 40 = Number of the physically present modules does not agree with the configuration							

Tab. 2/63: Function assignment and virtual modules

Do the following to use virtual modules in a configuration:

1. Set the CPX-FB14 in the pre-operational mode.
2. Define a possible configuration of your CPX terminal with the object 4800
   (requirement: 4800,0 = 0 and 4000 = 0):
   – 4800,1: module 0
   – 4800,2: module 1
   etc.
3. Write the number of the configured modules to the object 4800,0. As a result, the configuration defined by the objects 4800,1...4800,x are tested (target/actual comparison).
   – In case of a faulty target/actual comparison:
     The object 4800,0 is set to 0, an error code is entered in object 4801 and CPX error 29 is messaged with the emergency message.
   – In the case of a correct target/actual comparison:
     The function assignment masks are generated (objects 4001 and 4200) and digital outputs are reset (object 6200).
4. Activate the masks by setting the object 4000 to 1.
5. Adapt the PDO mapping (objects 160x and 1A0x), if you have defined virtual modules.

Configuration example with virtual modules

In the following example, the CPX terminal should be configured for two different functions using “Function assignment”:

– Function A = most complex CPX terminal of the system

– Function B = CPX terminal A without module 5 (8DI) and module 8 (MPA pneumatics module, 8DO).

Through the function assignment, the same PLC software can be used for terminals A and B without address shift. For terminal B, modules 5 and 8 are suppressed as virtual modules with object 4800.

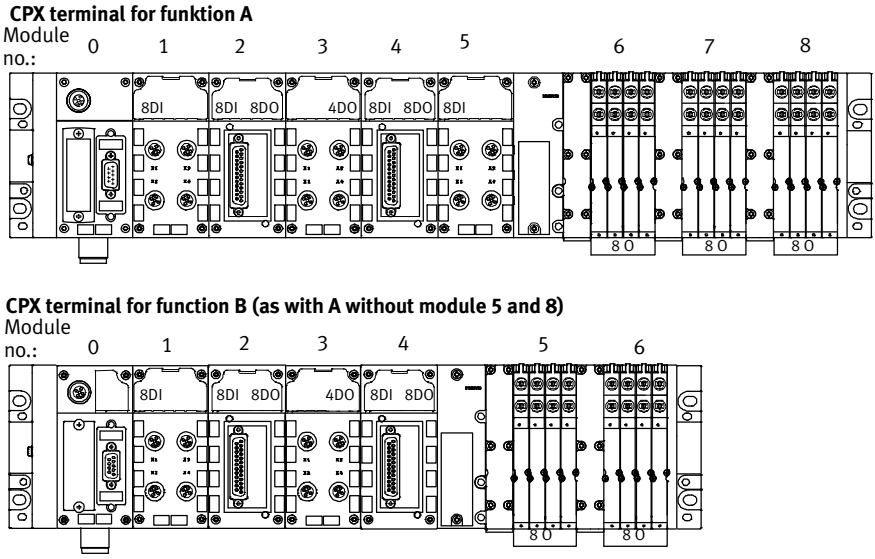


Fig. 2/7: Configure two variants of a CPX terminal with function assignment

Module no.		Module	I address [1]	O address [2]	Values fct. A	Values fct. B
A	B				Obj. 4800	Obj. 4800
0	0	CPX-FB14 With activated I/O diagnostic interface	T-PDO 4: IW0 Obj. 6100,1	R-PDO 4: OW0 Obj. 6300,1	Obj. 4800.1: 02 00 02 02	
1	1	CPX-8DE	T-PDO 1: I0 ... I7 Obj. 6000,1	–	Obj. 4800,2: 00 00 08 00	
2	2	CPX-8DE-8DA	T-PDO 1: I8 ... I15 Obj. 6000,2	R-PDO 1: O0 ... O7 Obj. 6200,1	Obj. 4800,3: 00 00 08 08	
3	3	CPX-4DA	–	R-PDO 1: O8 ... O11 Obj. 6200,2	Obj. 4800,4: 00 00 00 04	
4	4	CPX-8DE-8DA	T-PDO 1: I16 ... I23 Obj. 6000,3	R-PDO 1: O12 ... O19 Obj. 6200,2 Obj. 6200,3	Obj. 4800,5: 00 00 08 08	
5	–	CPX-8DE	T-PDO 1: I24 ... I31 Obj. 6000,4	–	Obj. 4800,6: **00** 00 08 00	Obj. 4800,6: **80** 00 08 00
6	5	MPA1S... (8DO)	–	R-PDO 1: O20 ... O27 Obj. 6200,3 Obj. 6200,4	Obj. 4800,7 00 00 00 08	
7	6	MPA1S... (8DO)	–	R-PDO 1: O28 ... O35 Obj. 6200,4 Obj. 6200,5	Obj. 4800,8 00 00 00 08	
8	–	MPA1S... (8DO)	–	R-PDO 1: O36 ... O43 Obj. 6200,5 Obj. 6200,6	Obj. 4800,9 **00** 00 00 08	Obj. 4800,9 **80** 00 00 08

[1] With mapping via object 1A00
[2] With mapping via object 1600

Tab. 2/64: Virtual modules in example terminal 1

2.5 Parameterisation

You can set the behaviour of the CPX terminal in the remote I/O operating mode through individual parameterisation. A distinction is made between the following parameterisation types:

– System parameterisation, e.g. switching off of error messages, etc.

– Parameterisation of the diagnostic memory.

– Module parameterisation (module- and channel-specific), e.g.: monitoring, settings in case of error, settings of debounce times of inputs.

Recommendation:
Parameterise the CPX terminal via the SDO in the pre-operational mode.

A detailed description of the individual parameters as well as basic principles of application can be found in the CPX system description (P.BE-CPX-SYS-...).
Parameter lists for CPX I/O modules and CPX pneumatic interfaces can be found in the description for the CPX I/O modules (P.BE-CPX-EA-...).

2.5.1 Parameterisation during switch-on

1 Parameterisation is loaded into the node by the master

2 Parameterisation is distributed to the modules from the node

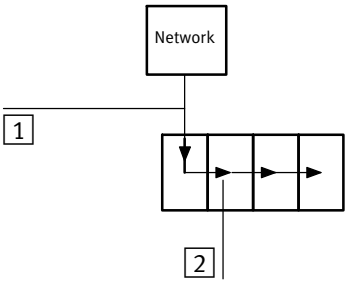


Fig. 2/8: Sequence of start parameterisation

2.5.2 Parameterisation with the handheld

The CPX handheld offers menu-driven access for parameterisation of the CPX terminal without configuration software.

Information on operating the handheld can be found in the relevant description.

2.5.3 Application example for parameterisation

1 Input with default parameterisation

2 Input with reduction of the input debounce time and increase of the signal extension time

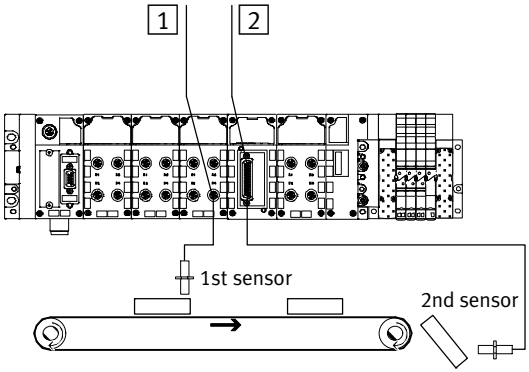


Fig. 2/9: Application example for parameterisation of debounce time and pulse lengthening (here on the right-hand sensor)

In the above application, packets are transported on a fast-moving conveyor belt. With the following parameterisation, signal detection and processing has been improved:

– Reduction of the input debounce time from 3 ms (factory setting) to 0.1 ms: detection of shorter signals is possible. (Applies to the complete module).

– Change in signal extension time to 50 ms:
The signal will be registered reliably by the controller. (Here activated only for the input channel of the 2nd sensor).

2.6 Commissioning the CPX terminal in the system

Note
Please observe also the switching-on instructions in the handbook for your controller.

Procedure:

1. Connect the fieldbus cable to the CPX bus node.
2. Switch on the operating voltages:
   - of all fieldbus stations,
   - of the CPX terminal.
3. Switch on the operating voltage for the master module.

Recommendation:
If the safety concept of your machine/system permits this, commission the CPX terminal with both operating voltages (pins 1 and 2) – but without compressed air. You can then test the CPX terminal without triggering accidental reactions.

2.6.1 Correct commissioning, normal operating status

In the normal operating status, the LEDs on the bus node light up as follows:

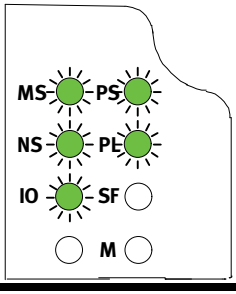
LED display		Operating status
	These LEDs light up green: – MS – NS – IO – PS – PL Red and yellow LEDs do not light up: – SF – M	Standard

Fig. 2/10: LEDs with normal operating status

Diagnostics

Chapter 3

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3. Diagnostics 3-1

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3.1 Summary of diagnostics options

The CPX terminal provides comprehensive and user-friendly options for diagnostics and error handling. The following options are available, dependent on the configuration:

Diagnostics option	Brief description	Benefits	Detailed description
LED display	The LEDs show directly configuration errors, hardware errors, bus errors, etc.	Fast “on-the-spot” error detection	Section 3.2
Status bits	Internal inputs that supply coded common diagnostic messages. The 8 status bits occupy the first 8 bits of the Transmit PDO 4 (➔ Fig. 2/1).	Fast access to error messages in the user program, independent of the interface and master.	Section 3.3 and CPX system description (P.BE-CPX-SYS-...)
I/O diagnostic interface	Bus-independent diagnostic interface at I/O level, which enables access to the internal data of the CPX terminal (16 bits, PDO 4)	Read access to internal parameters and data at I/O level.	Section 3.4 and CPX system description (P.BE-CPX-SYS-...)
Diagnostics via CANopen	– Emergency message – Objects 1001 ... 1003 – Diagnostics via SDO (e.g. objects 22xx)	Detailed error detection.	Section 3.5
Diagnostics via the handheld	Diagnostic information can be shown on the CPX Handheld in a convenient and menu-driven manner.	Fast “on-site” error detection without programming, in plain text	Description for the handheld

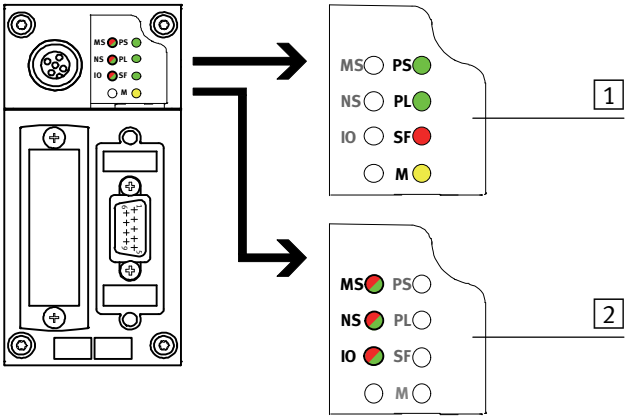
Tab. 3/1: Diagnostics options

Note
Note that the diagnostic information shown can depend on the settings (➔ section 1.2.2) as well as on the parameterisation (➔ section 2.5) of the CPX terminal.

3.2 Diagnostics via LEDs

LEDs for the diagnostics of the CPX terminal are available on the bus node as well as on the individual modules.

The significance of the LEDs on the electric modules can be found in the description for the relevant module.



1 CPX-specific LEDs:
- PS (green)
- PL (green)
- SF (red)
- M (yellow)

2 CANopen-specific LEDs (green/red):
- MS (module status)
- NS (Network status)
- IO (I/O status)

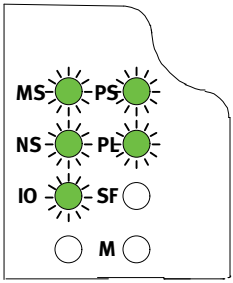
Fig. 3/1: LEDs of the CPX node

The LEDs are shown in their various statuses as follows:

Illuminated flashes off

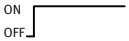
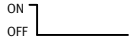
3.2.1 Normal operating status

In the normal operating status, the LEDs on the bus node light up as follows:

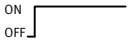
LED display		Operating status
	These LEDs light up green: – MS – NS – IO – PS – PL Red and yellow LEDs do not light up: – SF – M	Standard

Tab. 3/2: LEDs with standard operating status

3.2.2 Displays of the CPX-specific LEDs PS, PL, SF, M

PS (power system) – power sensor/logic supply			
LED (green)	**Process**	**Status**	**Significance/error handling**
LED illuminated		Not an error, operating voltage/ sensor supply applied	–
LED flashes		Operating voltage/ sensor supply outside the tolerance range	Eliminate undervoltage
		Internal fuse for the operating voltage/ sensor supply has responded	1. Eliminate short circuit/overload on module side 2. Dependent on the parameterisation of the module (module parameter): • The sensor supply voltage will be switched on again **automatically** after the short circuit has been eliminated (default) • Power Off/On is necessary
LED not illuminated		The operating voltage/sensor supply is not applied	Check the operating voltage connection of the electronics

Tab. 3/3: “PS” LED status display

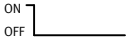
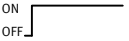
PL (power load) – power load supply (outputs/valves)			
LED (green)	**Process**	**Status**	**Significance/error handling**
LED illuminated		Not an error, load voltage applied	None
LED flashes		Load voltage at the system supply or additional power supply outside the tolerance range	Eliminate undervoltage

Tab. 3/4: “PL” LED status display

SF (system fail) – system error			
LED (red)	**Sequence** [1]	**Status**	**Significance/error handling**
LED not illuminated		No error	–
LED flashes 1x		Simple error / information (error class 1)	➔ description of error numbers in the CPX system description and in section 3.5.2.
LED flashes 2x		Error (error class 2)	
LED flashes 3x		Serious error (error class 3)	

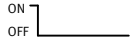
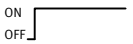
[1] The system error LED flashes dependent on the applicable error class.
Error class 1 (slight error): 1 * flash, pause
Error class 2 (error) 2 * flash, pause
Error class 3 (severe error): 3 * flash, pause

Tab. 3/5: “SF” LED status display

M (modify) – parameterisation updated or forcing active			
LED (yellow)	**Process**	**Status**	**Significance/error handling**
○ LED not illuminated		System start with default parameterisation (factory setting) and current CPX expansion set; external parameterisation is possible (presetting)	None
LED flashes		Force is active	The force function is enabled (➔ system parameter force mode; function no. 4402)
LED illuminated		System start with saved parameterisation and saved CPX expansion has been set; Parameters and CPX expansion are saved remanently; external parameterisation is blocked	Caution when replacing CPX terminals with saved parameterisation! With CPX terminals with saved parameterisation, parameterisation is not automatically restored by the higher-order PLC/IPC after replacement. In these cases, check which settings are required before the replacement and make these settings if necessary.

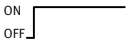
Tab. 3/6: “M” LED status display

3.2.3 Displays of the CANopen-specific LEDs MS, NS, IO

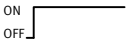
MS (module status)			
LED (green/red)	**Process**	**Status**	**Error handling**
LED not illuminated		LSS is activated No station number configured	• set station number and baud rate via LSS protocol, if necessary
LED illuminated green		Operational	–
LED flashing green	0.5 Hz	Pre-operational	• put CPX terminal into the operational mode, if necessary
LED flashes green fast	2 Hz	Stopped	• put CPX terminal into the operational mode, if necessary
LED illuminated red		Hardware error	Servicing required

Tab. 3/7: “MS” LED status display

NS (network status)

LED (green/red)	Process	Status	Error handling
LED illuminated green		Network OK	–
LED flashing green		Error counter overflow	• Check bus: cables, plug connectors, signal transmission
LED is flashing red		Failure of the 24 V CAN-receiver supply	• Check and restore power supply.
LED illuminated red		Bus OFF	• Check bus: cables, plug connectors, signal transmission (error counter overflow)

Tab. 3/8: “NS” LED status display

I/O status			
LED (green/red)	**Process**	**Status**	**Error handling**
LED illuminated green		I/O status OK	–
LED is flashing red		“I/O error” undervoltage, short circuit/ overload or wire fracture on a module	• Eliminate error on module
LED illuminated red		“Communication error” Node guard or heart beat elapsed (system goes into pre-operational mode)	1. Clarify reason for time out 2. Set CPX terminal to operational mode

Tab. 3/9: “I/O” status display

3.3 Diagnostics via status bits

The status bits serve to display common diagnostic messages (global error message).

Note
In order to use the status bits, they must be activated via DIL switches on the bus node (➔ section 1.2.2) or queried per SDO.

If status bits are activated, they occupy as standard 8 bits in the PDO 4 (➔ section 2.4.9).

Bit	Diagnostic information with logic 1	Description
0	Error at valve	Module type in which an error has occurred
1	Error at output	
2	Error at input	
3	Error on analogue module/ function module	
4	Undervoltage	Error type
5	Short circuit/overload	
6	Wire break	
7	Other error	

Tab. 3/10: Status bits of the CPX-FB14 (optional)

3.4 Diagnostics via the I/O diagnostic interface

The CPX terminal provides a 16-bit I/O diagnostic interface. The I/O diagnostic interface occupies as standard the bits 0 ... 15 of the PDO 4 (➔ section 2.4.9)

Note
In order to use the I/O diagnostic interface, the system diagnostics must be activated via the DIL switch on the bus node (➔ section 1.2.2).

Information on the I/O diagnostic interface can be found in the CPX system description P.BE-CPX-SYS-...

3.5 Diagnostics via CANopen

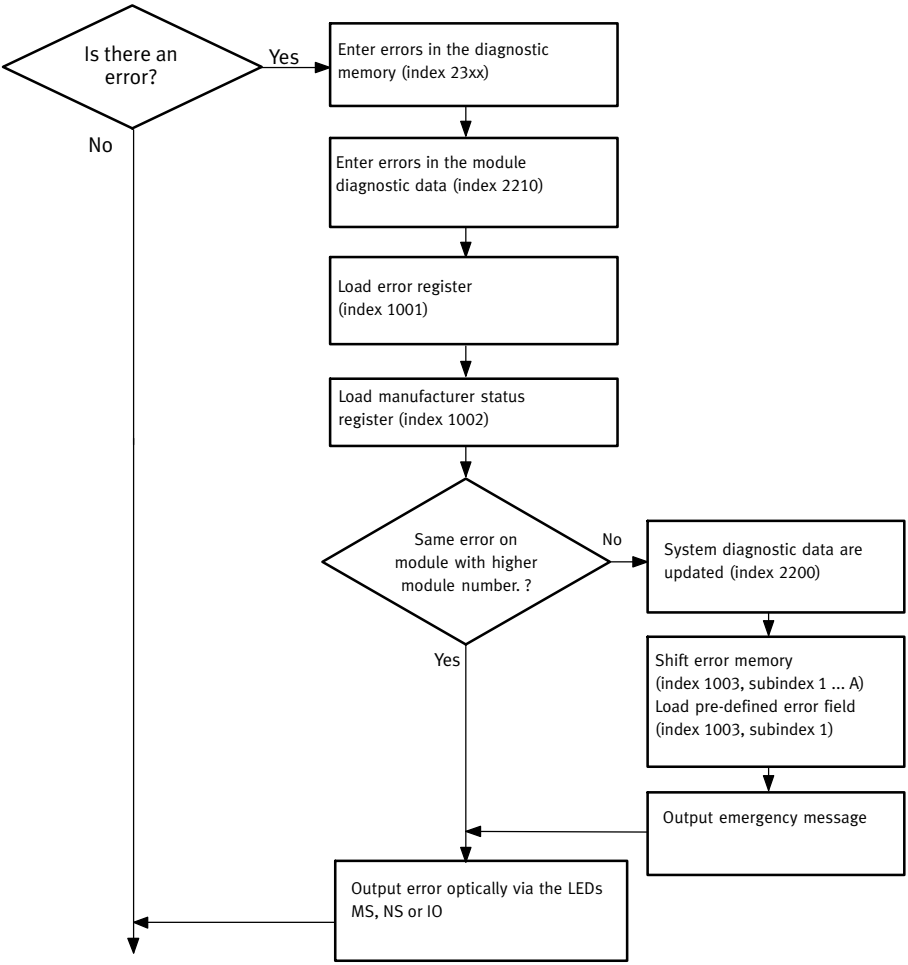

Is there an error?
Yes
No
Enter errors in the diagnostic memory (index 23xx)
Enter errors in the module diagnostic data (index 2210)
Load error register (index 1001)
Load manufacturer status register (index 1002)
Same error on module with higher module number. ?
No
Yes
System diagnostic data are updated (index 2200)
Shift error memory (index 1003, subindex 1 ... A)
Load pre-defined error field (index 1003, subindex 1)
Output emergency message
Output error optically via the LEDs MS, NS or IO

Fig. 3/2: Sequence of error processing in the CPX terminal

Information on the behaviour of the inputs and outputs in the event of an error can also be found in section 2.4.

3.5.1 The emergency message

If there is an error, the CPX terminal will transmit an emergency message, which consists of the following:

- byte 0, 1: Error code as per CiA 301/CiA 401
- Byte 2: Error register (index 1001)
- Byte 3 ... 7: Manufacturer-specific error field (contains device-typical error messages) Bytes 3 ... 6 form the manufacturer status register (index 1002).

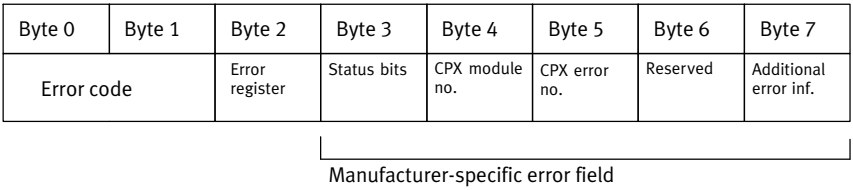


Fig. 3/3: Composition of the emergency object (additional information in Tab. 3/11 ... Tab. 3/16)

The pre-defined error field as error memory

If the emergency message is transmitted, a compressed form of the error information will be saved parallel in the pre-defined error field (index 1003):
status bits, CPX module number, error code

The pre-defined error field serves as error memory for the last 10 errors. Previous errors will each be shifted by one position (➔ section 2.4.1, index 1003, subindices 1 ... A_h).

Composition of the emergency message

Byte 0	**Byte 1**	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Error code		Error register	Status bits	CPX module no.	CPX error no.	Reserved	Additional error inf.
		Index 1001	Index 1002 (manufacturer status register)				

Byte 1	**Byte 0**	**Explanation**
00	00	No error
10	00	General error
23	20	Short circuit at outputs
23	30	Load dump (wire break)
31	20	Input voltage too low
33	20	Output voltage too low
50	00	Hardware error
81	00	Communication error (bus voltage not applied)
81	10	CAN overrun
81	20	CAN in error passive mode
81	30	Error with node guard or heart beat
81	40	CAN recovered from Bus OFF
82	10	Invalid PDO received

Tab. 3/11: Structure of the error code as per CiA 401

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Error code		Error register	Status bits	CPX module no.	CPX error no.	Reserved	Additional error inf.
		Index 1001	Index 1002 (manufacturer status register)				

Bit	Significance	Explanation
0	**Generic error**	Bit is set for each error
1	**Current**	– Short circuit/overload in sensor supply – Short circuit/overload at the outputs
2	**Voltage**	– U_{OUT} (undervoltage at the outputs) – U_{VAL} (undervoltage at valves) – Failure of load voltage at CPX output module or CPX input module
3	–	–
4	**Communication error**	– Node guard, heart beat, CAN error
5 ... 6	–	–
7	**Manufacturer specific**	– Wire break – Other error
bold = Bit is used by CPX terminal		

Tab. 3/12: Error register (index 1001 with bit assignment as per CiA 301/401)

Further diagnostic information is provided by the CPX terminal in bytes 3 ... 6 of the emergency object (manufacturer status register, index 1002).

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Error code		Error register	Status bits	CPX module no.	CPX error no.	Reserved	Additional error inf.
		Index 1001	Index 1002 (manufacturer status register)				

Bit	Significance	Explanation
0	Error at valve	Module type in which an error has occurred
1	Error at output	
2	Error at input	
3	Error on analogue module/function module	
4	Undervoltage	Error type
5	Short circuit/overload	
6	Wire break	
7	Other error	

Tab. 3/13: Byte 0 of the manufacturer status register (status bits)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Error code		Error register	Status bits	CPX module no.	CPX error no.	Reserved	Additional error inf.
		Index 1001	Index 1002 (manufacturer status register)				

Bit	Significance	Explanation
0 ... 7	CPX module number	Number of the module with diagnostic message

Tab. 3/14: Byte 1 of the manufacturer status register (CPX module number)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Error code		Error register	Status bits	CPX module no.	CPX error no.	Reserved	Additional error inf.
		Index 1001	**Index 1002 (manufacturer status register)**				

Bit	Significance	Explanation
0 ... 7	CPX error number	CPX error number (➔ section 3.5.2)

Tab. 3/15: Byte 2 of the manufacturer status register (CPX error number)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Error code		Error register	Status bits	CPX module no.	CPX error no.	Reserved	Additional error inf.
		Index 1001	Index 1002 (manufacturer status register)				

Bit	Significance	Explanation
0 ... 7	Additional information on the fault	E.g. – Node ID with heart beat error (which participant has caused the time out) – Channel number of the first channel with fault

Tab. 3/16: Byte 7 of the emergency object

3.5.2 CPX error numbers

The table on the following pages shows the CPX error numbers.

Detailed information can be found in the CPX system description in the chapter “Diagnostics and error handling”.

Error number	Error type
0	No error
1	General diagnostics
2	Short circuit/overload in sensor supply (SCS) or at output (SCO)
3	Wire fracture/idling at current input/output
4	Failure of load voltage supply due to short circuit/overload (on output side)
5	Undervoltage in power supply (on input side)
6 ... 8	Reserved
9	Value falling below nominal range
10	Value exceeding nominal range
11	Short circuit at valve
12	Reserved
13	Wire break at valve (open load)
14	Reserved
15	Module/channel failed
16	Module code invalid or incorrect module
17	Incorrect I/O length (e.g. CPX-CP interface)
18	Number of I/O points exceeded
19	Reserved

Tab. 3/17: CPX error numbers (part 1)

Error number	Error type
20	Parameterisation error: configurable signal range
21	Parameterisation error: data format
22	Parameterisation error: data for linear scaling
23	Parameterisation error: digital filter/measurement value smoothing
24	Parameterisation error: lower limit value
25	Parameterisation error: upper limit value
26	Error in actuator supply for analogue output module
27 ... 28	Reserved
29	Parameterisation error
30 ... 39	Reserved
40	Life guard
41	Heart beat
42	Reserved
43	CAN overrun
44	Invalid PDO received
45	CAN warn limit reached
46	Recovered from bus off
47	Bus power lost
48 ... 127	➔ CPX system description
128 ... 199	Error in CPX structure (error number is error information for service personnel)

Tab. 3/18: CPX error numbers (part 2)

Error number	Error type
200	Error in parameter transfer to module
201	Invalid station number (node)
202	Bus protocol chip: not ready
203	Reserved
204 ... 205	➔ Description for the respective module

Tab. 3/19: CPX error numbers (part 3)

Technical appendix

Appendix A

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A. Technical appendix A-1

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A.1 Technical data, bus node CPX-FB14

General	
General technical data	➔ CPX system description P.BE-CPX-SYS-...
Degree of protection provided by housing [1] according to IEC/EN 60529, CPX-FB14 completely mounted, plug connector inserted or provided with cover cap	IP65/IP67
Protection against electric shock Protection against direct and indirect contact as per IEC/DIN 60204-1	through the use of PELV circuits (Protected Extra Low Voltage)
Module code (CPX-specific)	Remote I/O: CD_h Remote controller: $9C_h$
Module identifier (in the handheld)	Remote I/O: FB14-RIO CANopen remote I/O Remote controller: FB14-RC CANopen bus node
[1] Note that connected devices may only satisfy a lower protection class, a smaller temperature range, etc.	

Tab. A/1: General technical data

Power supply	
Operating voltage/load voltage	➔ CPX system description P.BE-CPX-SYS-...
Current consumption bus node CPX-FB14 – from operating voltage supply for electronics/sensors (U_{SEN})	max. 200 mA (only CPX-FB14)
Operating voltage for bus interface Sub-D plug: pin 3, pin 9 M12 adapter: pin 2, pin 3 Screw terminal adapter: pin 1, pin 5 – Current consumption – Nominal value – Tolerance	 Max. 30 mA 24 V DC (protected against incorrect polarity, external fuse required) 11 ... 30 V
Galvanic isolation	Bus interface opto-decoupled

Tab. A/2: Power supply

Technical data for the pneumatics can be found in the description of pneumatics.

A.2 Examples: Communication sequence

All examples refer to module ID = 1, i.e. set station number of the CPX terminal = 1.

A.2.1 Example 1: Start CANopen network

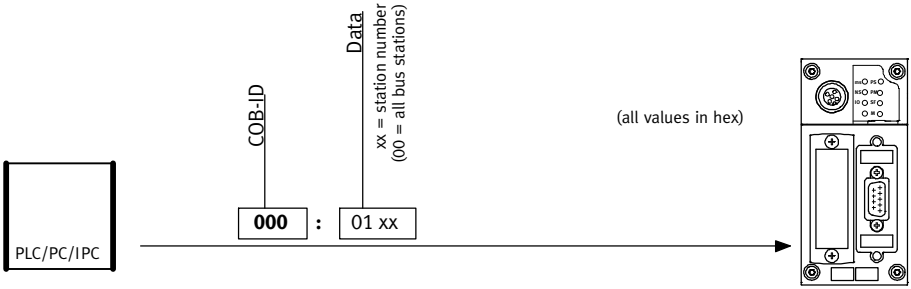

Fig. A/1: Example 1, start CANopen network

A.2.2 Example 2: Set output

In order to set outputs or valves on the CPX terminal, the receive PDO must be sent by the master. In the example, only output 0 is set; any outputs already set will be reset.

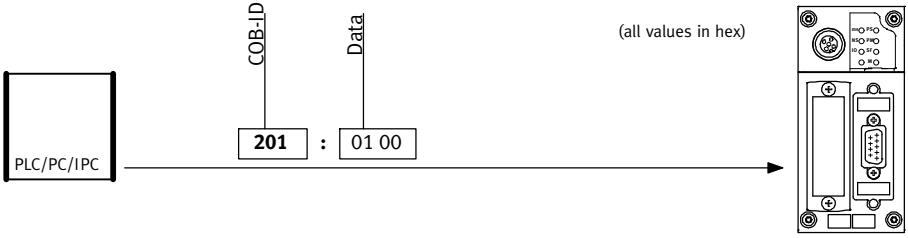

Fig. A/2: Example 2, set output 0 of the CPX terminal

A.2.3 Example 3, Start “node guard” monitoring

First load the indices 100C and 100D via SDO transfer (➔ example 5). The “node guard” monitoring of the CPX terminal starts when the first “node guard” telegram is received. This telegram must be cyclically repeated within the timeout time:
timeout time = guard time · lifetime factor
= index 100C · index 100D

If this time is exceeded, the valves/outputs will be switched off or they will assume the fail-safe status.

➔

Note
Until the first “node guard” telegram is received, the timeout monitoring in the CPX terminal is inactive: Valves and outputs which are switched on remain set even after loss of communication, bus interruption, etc.

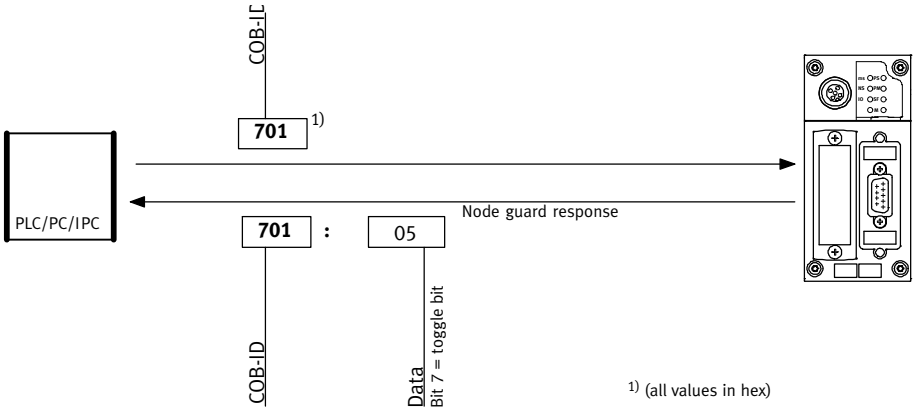

Fig. A/3: Example 3, start “node guard” monitoring (Remote request)

A.2.4 Example 4: load objects

Objects of a CPX terminal can be loaded or read via SDO transfer:

– Upload command

– Index and subindex

The CPX terminal then sends:

– Index and subindex

– Data bytes

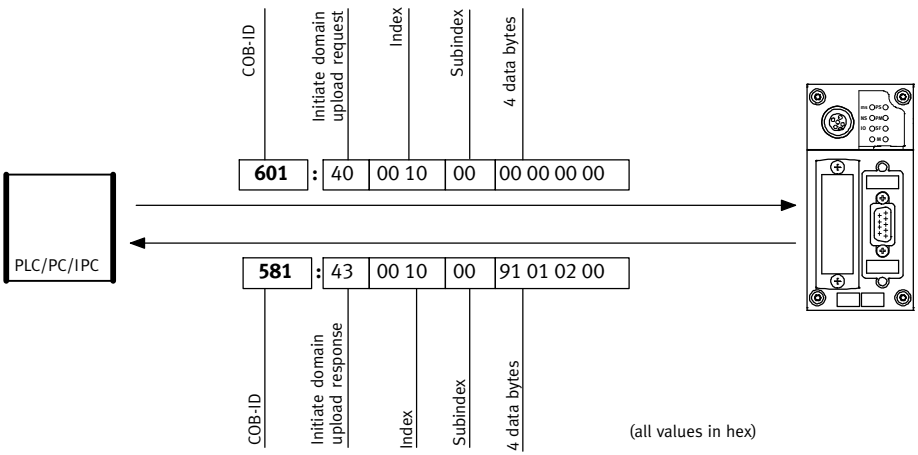

Fig. A/4: Example 4, index 1000_h, read subindex 0 (device type: device profile, device extension)

A.2.5 Example 5: write objects

In order to write objects of a CPX terminal, you must load the following via SDO:

– Download command

– Index and subindex

– Value

The CPX terminal then sends as acknowledgement:

– Index and subindex

– Data bytes (not relevant)

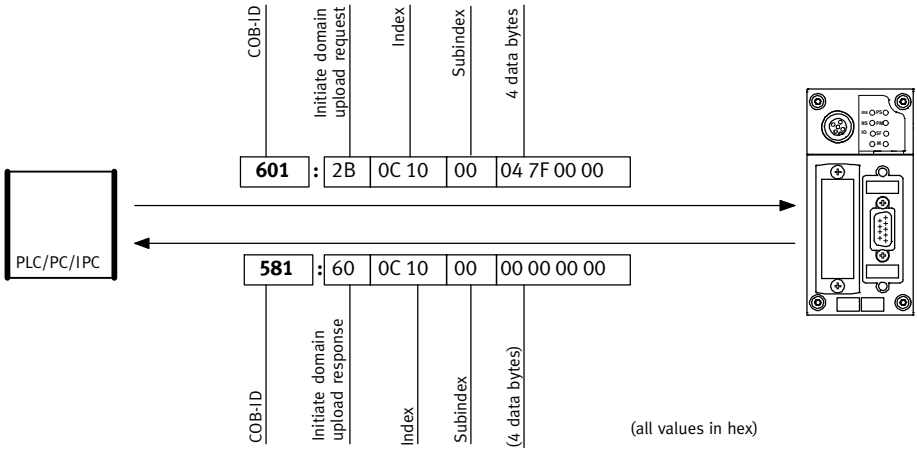

Fig. A/5: Example 5: Index $100C_h$, write subindex 0 (guard time)

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